Management of Hazardous Waste
A Policy and Procedures Manual

Chemical Waste Section

Yale *Environmental Health & Safety*
Environmental Affairs Section
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TABLE OF CONTENTS

Section 1 Management of Hazardous Waste

1.1 Responsibilities for Hazardous Waste Management

The Hazardous Waste Management Program is designed to facilitate the safe storage, pick up, and disposal of hazardous waste produced at Yale University. In order to succeed, the Office of Environmental Health and Safety (OEHS) needs the cooperation of all University staff and faculty. Each group in the University has an important function and responsibility in handling hazardous waste. Should you have questions about hazardous waste or other environmental health and safety issues, or wish to explore use of less hazardous materials, contact the Office of Environmental Health and Safety at 785-3550.

1.1.1 President of Yale University:

is ultimately responsible for all institutional health and safety matters, including hazardous waste management. With the President and other officers and administrators, lies the responsibility of providing continual leadership support for the hazardous waste program and implementation of University policies and guidelines. On a day-to-day basis, the Deputy Provost for Biomedical and Health Affairs carries out these responsibilities as the President's designee for environmental health and safety matters.

1.1.2 University Safety Committee (USC):

advises the President, Provost, Deputy Provosts, and the OEHS on matters pertaining to safety within the University. The Committee review waste management guidelines and advises the Director of OEHS about issues relating to the development and implementation of new hazardous waste programs. Various other committees, including the biological, laboratory, and radiation safety committees, provide advice and report to the USC about specific environmental health and safety issues.

1.1.3 Environmental Services Section (ESS):

is the section of OEHS that is responsible for managing all hazardous waste activities within the University. Their specific responsibilities include:

- Implementing federal, state, and local regulations pertaining to the handling, storage, transportation, and disposal of hazardous waste;
- Preparing, submitting, and maintaining applicable records, reports, and manifests;
- Implementing and improving procedures for deactivation, treatment in laboratory, and disposal of hazardous waste; and,
- Providing technical assistance and training to the University community on identifying and disposing of waste.

1.1.4 Principal Investigators, Supervisors, and Teaching Lab Managers:

have the primary responsibility for ensuring that the University community follows policies and guidelines established in this manual.

1.1.5 Laboratory Workers and Staff Employees:

have critical hands-on, day-to-day responsibilities for the success of the Hazardous Waste Management Program. These responsibilities include:

- Managing and disposing all wastes in accordance with established procedures;
- Packaging and labeling surplus chemicals and hazardous waste appropriately;
- Using all necessary personal protective equipment and safety devices; and,
- Seeking advice, when necessary, from ESS, their supervisor or instructor about the proper handling and disposal of hazardous waste.

Section 2 Chemical Waste Management

2.1 Definition of Chemical Hazardous Waste

The 1976 Resource Conservation and Recovery Act ("RCRA"), and its subsequent 1984 Hazardous and Solid Waste Amendments required the United States Environmental Protection Agency ("EPA") to issue federal regulations to manage hazardous waste, including defining what is hazardous chemical waste. The Connecticut Department of Environmental Protection ("CTDEP") also regulates hazardous chemical waste. Hazardous chemical waste by legal definition, is "solid" waste (this includes solid, liquid, and gaseous material) that meets specific criteria, and is either listed as a hazardous waste, or exhibits any of the characteristics of a hazardous waste. The EPA describes solid waste as: *Any solid, liquid or contained gaseous material that is being disposed of (including being burned or incinerated) or recycled, or being accumulated, stored, or treated before being disposed of or recycled.*

If a waste meets the definition of solid waste and is not otherwise exempt from being a hazardous waste, then a hazardous waste determination needs to be made. Following is the method to determine if your solid waste is a hazardous waste.

2.1.1 Unused Chemicals

If the material is an unused chemical or from a spill of an unused chemical, check whether the material is listed as an acute hazardous waste ("P" list, shown in Appendix A) or toxic hazardous waste ("U" list, shown in Appendix B). If the chemical is listed, then it is a hazardous waste. If it is not listed, refer to "Characteristic Waste" below.

2.1.2 Waste from Procedure/Experiment

If the material is a waste from a protocol or is otherwise used, check to see if the waste is listed in Appendix C ("F" listed waste). If it is not listed refer to "Characteristic Waste" below.

2.1.3 Characteristic Waste

If the waste material is an unused or used chemical that is not listed, or if it is any other waste material, determine if the chemical meets any of the characteristics of a hazardous waste. Any waste material that meets one or more of the following characteristics is considered hazardous waste:

- Ignitability
  - It is a liquid with a flash point less than 60°C (140°F), unless it is an aqueous solution containing less than 24 percent alcohol by volume.
  - It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.
  - It is an ignitable compressed gas.
  - It is an oxidizer as described in DOT regulations.
- Corrosivity
  - It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5
  - It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55°C (130°F)

- ♦ Reactivity
  - It is normally unstable and readily undergoes violent change without detonating.
  - It reacts violently with water.
  - It forms potentially explosive mixtures with water.
  - When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.
  - It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.
  - It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
  - It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
  - It is a forbidden explosive per Department of Transportation regulations.
- ♦ Toxicity

A waste is considered to exhibit the characteristic of toxicity if it is in solution in amounts greater than the regulatory levels listed in Table 1 (on the following page) or, if the leachate (using the Toxicity Characteristic Leaching Procedure Test, or "TCLP") meets or exceeds these regulatory levels. For liquids, the TCLP result is approximately the same as the actual mass concentration. For solid state materials that contain any of the listed contaminants, the TCLP test needs to be conducted to determine if the waste is hazardous. Should your waste stream require such testing, please contact ESS at 785-3550 for assistance.

Table 1--Maximum Concentration of Contaminants for the Toxicity Characteristic

EPA HW No.1	Contaminant	CAS No.	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	200.0
D024	m-Cresol	108-39-4	200.0
D025	p-Cresol	106-44-5	200.0
D026	Cresol		200.0
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentrachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	3-72-1	1.0
D043	Vinyl chloride	75-01-4	0.2

Sources of Information

An important source of information regarding the chemicals you use is the Material Safety Data Sheet (MSDS). MSDSs are provided by the chemical supplier and give general health and safety information about handling these chemicals, including emergency response and disposal. Sigma Aldrich MSDSs on CD-ROM are available in the Medical School Library, Becton Library, Kline Science Library, and Chemistry instrumentation room. MSDSs are also available on-line (see OEHS homepage at www.yale.edu/oehs for links). MSDSs will not provide you with all of the answers to your questions, but they can help you identify characteristics of your hazardous waste such as flashpoint and pH. Chemical hazardous waste web-based training is located at "http:\\info.med.edu\yale.edu\chemhaz". This course should be taken by all hazardous waste generators, and covers the proper methods to manage chemical waste including waste determination.

Connecticut Regulated Waste

Some chemicals are also regulated if they meet criteria set forth by the Connecticut Department of Environmental Protection (CTDEP), e.g. waste oil, PCBs, anti-freeze. Connecticut Regulated Waste cannot be disposed of in normal trash and must be picked up by ESS.

2.2 Accumulation in Laboratories and Work Area

EPA and CTDEP regulations set forth the requirements for proper hazardous chemical waste storage and labeling as they are being accumulated in the work area. These areas are called "satellite accumulation areas."

2.2.1 Satellite Accumulation Areas (SAA) rules:

- Hazardous chemical waste must be stored only in designated satellite accumulation areas (SAA) which must be in close proximity of waste generation locations. Hazardous waste generated in one lab cannot be stored in another lab, or in a room across a hallway.
- The waste containers must always be closed except when it is necessary to add or remove waste. Use non-leaking screw-on caps that are safe for transport.
- All hazardous waste containers must be clearly labeled with the words "Hazardous Waste" as soon as any waste is placed in the container. You may use the labels and tags available from ESS.
- Clearly indicate the complete chemical name in English on the container, as soon as any waste is placed in the container. Chemical abbreviations or formulas are not acceptable, nor are generalizations such as "halogenated waste." If more than one chemical is placed in a container, attach a list of the chemicals added to the container and maintain a log of the quantities.
- Chemical waste containers must also be segregated by hazard class and compatibility. (e.g. acids must be separated from bases and flammables). ESS will provide secondary containers for this purpose. You may also use a liquid proof partition, wall or other device for separation purposes.
- Waste containers must be in good condition, not leaking or rusted, and compatible with the wastes being stored (i.e. acids not to be stored in metal cans). Hazardous waste must not be placed in unwashed containers that previously held an incompatible material.
- A generator may accumulate in a SAA up to a total of 55 gallons of regular hazardous waste and no more than a total of one quart of acutely hazardous wastes (P listed wastes, see Appendix A). If a process will generate more than this amount at any time, contact ESS in advance to arrange a special waste pick-up. However it is recommended to call for a pick-up as soon as any container is full.
- The posting shown in Appendix G is REQUIRED to be present at every satellite accumulation area. Contact ESS at 785-3550 to obtain posting.

2.3 Packaging of Chemical Waste

- Liquid materials that are to be disposed of as hazardous waste should be placed in appropriate containers with adequate closure. Corks or parafilm are not considered adequate for closure.
- If possible use the original container. Most containers except larger reusable containers will not be returned.
- Containers must be kept closed except during actual transfers (Do not leave a hazardous waste container with a funnel in it).
- The container should not react with the waste being stored. (e.g. no hydrofluoric acid in glass).

- Waste containers must be filled to a safe level (not beyond the bottom of the neck of the container or a 2-inch headspace for 55 gallon drums). Over-filled containers are difficult to pour safely, may splash upon opening, and could be subject to leaking or bursting.
- Similar wastes may be mixed if they are compatible (e.g. flammable liquids).
- Wastes from incompatible hazard classes should not be mixed (e.g. flammables with oxidizers). Whenever possible keep different hazardous waste separated so that disposal can remain more cost effective. Separate wastes in the following categories:
    1. Miscellaneous solids (e.g. spill clean-up material, grossly contaminated gloves, rags, and towels) should be separated from liquid waste
    2. Halogenated solvents (e.g. methylene chloride, chloroform, carbon tetrachloride)
    3. Non-halogenated solvents (e.g. xylene, toluene, alcohols). Disposal of non-halogenated solvents costs half as much as halogenated solvents
    4. Waste oil must be kept uncontaminated so it is possible to recycle
    5. Acids
    6. Bases
    7. Metal bearing wastes. Specific metals of concern are arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.
    8. Special waste such as cyanides, sulfides, pesticides, oxidizers, organic acids, explosives and peroxides, should be collected individually and stored separately.
    9. Mercury and mercury containing compounds. All mixtures containing mercury in any form must be disposed as mercury contaminated waste.

- Label each hazardous waste container with a hazardous waste label at the moment waste is added to the container.

- Liquid waste must not contain solids.

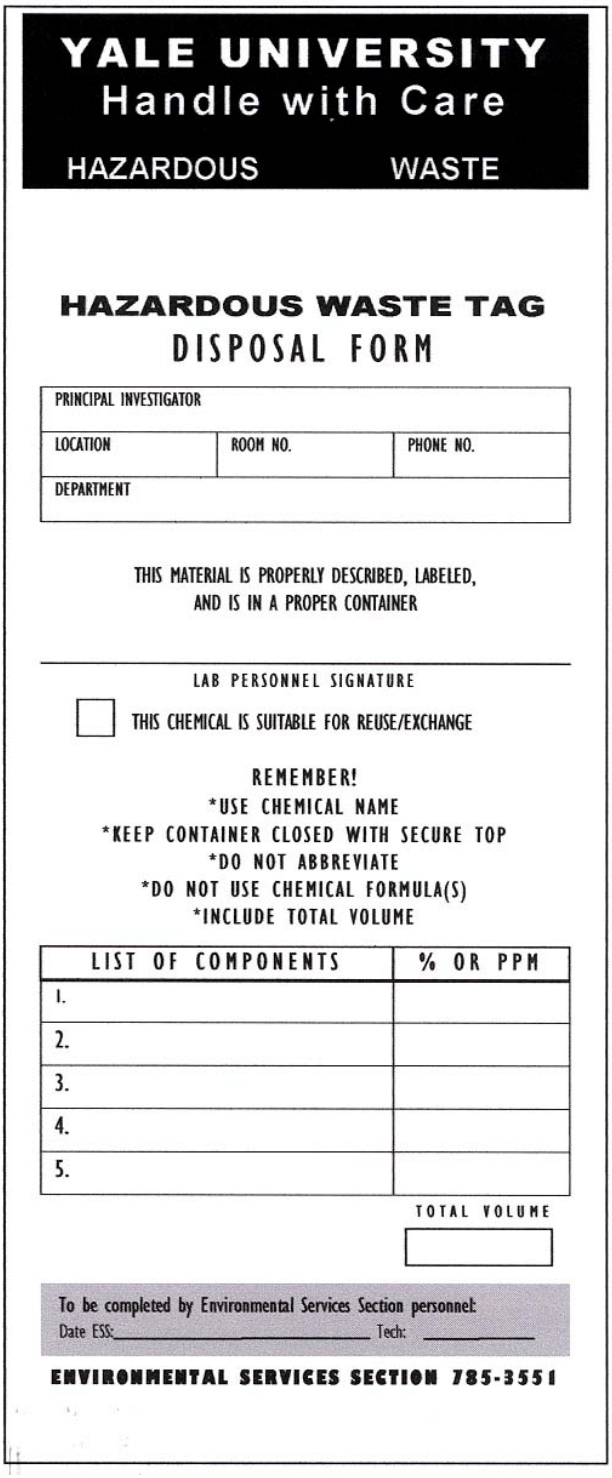
- Solid waste material (e.g. absorbents from a spill clean up of a listed waste) must be in sealable containers suitable for transportation. Clear plastic bags must be used for soft items to allow visual inspection by ESS. Sharps and piercing objects must be placed in a rigid puncture resistant container. Do not use container with biohazard symbol.

- All containers must be leak-proof and free of exterior contamination.

2.4 Waste Tags

Before chemical waste can be picked-up by ESS, a waste tag is required to be attached to the container (see Figure 1 on following page). It should be filled out by the individual generating the waste and attached to each container. This should be done as soon as the container is full. The information on the tag is essential to categorize and package wastes for final disposal. Please complete all the information legibly, accurately and completely. Please include the following information:

- Generator (Principal Investigator): name and telephone number of the individual responsible for supervising the process generating the waste.
- Amount: the total volume of chemical in the container.
- List of components: Full chemical name (no formula or abbreviations) and the percentages of total volume to which each chemical amount is equal (should add to 100%), the actual weight or volume of each constituent, or the parts per million ("ppm") of each constituent.
- If waste is not a hazardous waste, cross out the word "Hazardous" on the waste tag.
- Tags are available free of charge in the KBT, Chemistry, and Medical School stockrooms.
- If performing a large laboratory clean out, call the Environmental Service Section (ESS) at 785-3550 for special lab clean-out sheet and instructions.



YALE UNIVERSITY
Handle with Care
HAZARDOUS WASTE

HAZARDOUS WASTE TAG
DISPOSAL FORM

PRINCIPAL INVESTIGATOR		
LOCATION	ROOM NO.	PHONE NO.
DEPARTMENT		

THIS MATERIAL IS PROPERLY DESCRIBED, LABELED,
AND IS IN A PROPER CONTAINER

LAB PERSONNEL SIGNATURE

☐ THIS CHEMICAL IS SUITABLE FOR REUSE/EXCHANGE

REMEMBER!
*USE CHEMICAL NAME
*KEEP CONTAINER CLOSED WITH SECURE TOP
*DO NOT ABBREVIATE
*DO NOT USE CHEMICAL FORMULA(S)
*INCLUDE TOTAL VOLUME

LIST OF COMPONENTS	% OR PPM
1.	
2.	
3.	
4.	
5.	

TOTAL VOLUME

To be completed by Environmental Services Section personnel:
Date ESS:_____ Tech: _____

ENVIRONMENTAL SERVICES SECTION 785-3551

Figure 1

2.5 Request for Disposal

When container is ready for disposal and is properly tagged, contact OEHS at 785-3551 to request a pick-up, or fax us a copy of the "Chemical Disposal Request" form, shown in Appendix D, to 432-6148.
The request must provide information on name, telephone number, Principal Investigator, department, building and room number, container size, chemical names, physical state, hazard type, and any special hazards.

2.6 Chemicals for the Normal Trash

Many solid chemicals can be safety discarded into the normal trash, provided they are in containers that are not broken or cracked and have tightly fitting caps. These chemicals are considered acceptable for ordinary disposal because they display none of the properties of hazardous waste, are of low acute toxicity, and have not been identified as having any chronic toxic effects as summarized in the National Institute of Occupational Safety and Health (NIOSH) "*Registry of Toxic Effects of Chemical Substances"*.

Chemicals acceptable for disposal as regular trash are listed in Appendix E. To dispose of these chemicals, place the containers in a box lined with a plastic bag, tape the top of the box shut, write "Normal Trash" on the box and then place the box next to the lab trash container. Only solid forms of these chemicals can be disposed in this manner. Any questions about these chemicals should be directed to Environmental Services at 785-3550.

Solid materials, such as pipette tips, plastic backed bench towels, gloves etc., that are minimally contaminated with chemicals (other than P-listed acutely toxic waste) and are drip-free, may also be disposed of in normal trash. Items that could rip a bag should be placed into a large mouth jar, which when full should be closed and placed in normal trash. Solid materials that contain trace amounts of acutely toxic hazardous waste (P-listed waste) should be disposed of through ESS as Connecticut Regulated Waste. Note that sharps (e.g., syringes, needles) must be disposed in sharps disposal containers, regardless of whether they were used with any biological materials.

2.7 Chemicals for the Sanitary Sewer

Some chemicals that are water-soluble and of low toxicity can be safely discarded in the sanitary sewer. Since any material poured down a drain eventually flows into the City of New Haven Sewage Treatment Facility, and ultimately New Haven Harbor and the Long Island Sound, the University is regulated by the City of New Haven Sewer Ordinance and the CTDEP concerning the types and quantities of materials that can enter the sewer system. Beyond the legal requirements, the University also has ethical obligations to protect our environment.

Certain criteria must be met in order for materials to be safely poured down the drain, including low toxicity, high water solubility, and moderate pH. Only small quantities are allowed in the system at any time and the chemicals must be degradable by the wastewater treatment (a biological process). Large quantities or highly concentrated stock solutions of these materials should be picked up for disposal by ESS.

Only aqueous solutions of these chemicals can go down the lab drain; solid forms must use other disposal routes (normal trash or pick-up by Environmental Services). A complete procedure and a list of chemicals acceptable for sewer disposal appears in Appendix F.

2.8 Special Waste Items for Collection

See Appendix N for guidance on the following special waste items:

- Batteries
- Compressed Gas Cylinders
- Ethidium Bromide
- Mercury
- Oil, Waste

- Paint and painting supplies
- Photographic Chemicals and Silver Recovery
- Polychlorinated Biphenyls (PCBs)

2.9 Disposal of Empty Containers

Empty containers that are no longer needed must be disposed of properly:

- A container that never held acute hazardous waste is considered empty if all the following conditions exist:
  - all chemical has been removed by pouring, pumping, or aspirating;
  - there is less than one inch of residue left in the bottom of the container or;
  - there is less than 3% (0.3% for containers >110 gallons) by weight of residue left in the container and;
  - for gas cylinders, the contents are essentially at atmospheric pressure.
- Containers that once held acute hazardous waste (P-listed waste, Appendix A) require special handling. For these materials, the container is considered empty if it has been triple-rinsed using a suitable solvent. The rinsate itself becomes hazardous waste. If the container is not first cleaned as stated above, then the container also becomes a hazardous waste.
- Once a container has been "emptied" by the appropriate criteria, the label must be defaced by either removing it, spray painting over it, or covering it with a bold marker. Then rinse the container with water to remove any residue, then place into the normal trash.

2.10 Chemicals that Require Special Handling

When calling for the disposal of any of the listed acutely hazardous chemicals, be sure to specify the hazard so precautions are taken.

2.10.1 Explosive and Highly Reactive Chemicals

Some laboratory chemicals are potentially explosive materials. Prudent Practices in the Laboratory (National Research Council) has a list of shock-sensitive compounds which include:

Acryl
Alkyl nitrates
Alkyl perchlorates
Azides
Diazo compounds
Dry diazonium salts
Hydroperoxides
Metallic azides
Metals, powdered
Nitrocellulose
Oxidizing agents, strong
Picric acid (Picric acid is usually purchased containing 10-15% of water, a condition under which it is relatively safe. However, if allowed to dry, picric acid becomes highly shock sensitive, and must be treated as a dangerous explosive)
Poly-nitro-alkyl/aromatic compounds
Peroxides
Reducing agents, strong

2.10.2 Peroxide Forming Compounds

Sensitive to light and heat, this class of compounds reacts with air and light to form unstable peroxides. Before opening containers of peroxide forming solvents, check for crystal formation that may indicate the presence of peroxides. Do not open any container that has crystals around the cap or has a fitted glass top or metal cap as it may cause sparks. Peroxides are shock and heat sensitive. Once opened, stocks of these peroxides forming chemicals should be used within the

specified time frame. It is essential to indicate the date at the time of opening and dispose of in specified periods of time. After six months they must be tested for peroxide formation. These tests are easily done with inexpensive test strips (e.g., catalog #5A-1162 available from Lab Safety Supply at 800-356-0785). Never distill peroxide-forming solvents unless first tested and found to be free of peroxides. Peroxides concentrated in the pot residue still pose a serious explosion hazard and must be handled carefully.

Solvents which may form peroxides after 6 months (3 months after opening) include:	**Solvents which may form peroxides after 12 months (6 months after opening) include:**	**Solvents which may form peroxides after 24 months include:**
Cyclohexanes Cyclooctene Diethyl ether Dioxanes Isopropyl ether Sodium amide Tetrahydrofuran	Acrylonitrile Butadiene Chlorotrifluoroethylene Tetrafluorethylene Vinyl chloride Vinyl ethers Vinylidene chloride	Acetal Acrylic acid Chloroprene Diethylene glycol dimethyl ether (Diglyme) Decahydronaphthalene (Decalin) Dicyclopentadiene (Tetralin) Dimethyl ether Diacetylene Methyl acetylene Methyl methacrylate Styrene Diacetylene Tetrahydronaphthalene Vinyl pyridine

(Note: " petroleum ether" is often erroneously treated as if it were in the ether chemical class. Petroleum ether is a mixture of light hydrocarbons and, although highly flammable is not a peroxide-forming material.)

2.10.3 Strong Oxidizing/Reducing Agents

This class of chemicals causes severe reactions when mixed with incompatible materials including violent polymerization with generation of heat, production of unstable or pyrophoric compounds, and production of flammable gases. Fire may also result.

These chemicals include:

Oxidizing agents	Reducing agents
Chromic acid (fresh)	n-butyl lithium
Metallic chlorates	Metallic sulfides
Metallic nitrates	Calcium hydride
Metallic perchlorates	Sodium hydride
Perchloric acid	Stannous chloride
Peroxides	

2.10.4 Other Reactive Materials

This group of chemicals contains all the other reactive/explosive chemicals including water reactive, sulfides, and cyanide compounds. Cyanides and sulfides should be kept away from acids.

These chemicals include:

Acetyl chloride
Anhydrous aluminum chloride
Arsenic
Benzyl peroxide
Bromine
Calcium metal

Chlorosulfonic acid
Cyanide compounds
Lithium metal
Metal hydrides
Nitric acid above 40%
Phosphorus (all forms)
Phosphorus pentoxide
Potassium metal
Selenium
Silanes
Sodium metal
Sulfide compounds
Tellurium
Thionyl chloride

2.10.5 Heavy Metals

The EPA has banned heavy metals from land disposal. All heavy metals compounds must be kept separate from other materials to facilitate disposal.

Examples of heavy metals are:

Arsenic	Barium
Cadmium	Chromium
Lead	Mercury
Selenium	Silver

2.11 Unknown Chemicals

Unknown chemicals present serious problems, since without a label or description, chemicals can neither be handled nor disposed of safely. Federal and State regulations mandate that all hazardous waste containers are properly labeled with their content. Large fines can be imposed for violations of these laws. EPA automatically considers an unlabelled container an unknown hazardous waste. Finally, unknown chemicals require considerable time and money to characterize sufficiently for safe disposal.

The best solution to unknown chemicals is to prevent their occurrence. Periodically inspect all chemical containers for missing or damaged labels. Immediately replace or supplement hard to read labels with all essential information. NEVER COLLECT ANY MATERIAL IN AN UNMARKED CONTAINER WITH THE INTENT ON LABELLING IT LATER-LABEL IT IMMEDIATELY. Label commercial products transferred to other containers not only with their name, but also the manufacturer's name and address. The latter information is essential to obtain all MSDSs for the material. Any information that you can provide will make identification of unknowns and subsequent disposal faster, safer, and cheaper. Gather as much physical information as possible.

- Is it a solid, liquid, gas or mixture
- Type of container used
- What type of materials are commonly used in the area where container was found
- Is it organic or inorganic
- Is it soluble in water

Basic qualitative analyses and other tests can be performed on the unknowns. The following references explain methods for identifying unknown chemicals.

Blaine C. McKusick, "*Classification of Unlabelled Laboratory Waste for Disposal*" Journal of Chemical Education Volume 63, 1986, pp 128-131.

Shriner, R.L.; Fuson, R.C. Curtin, D.Y. Morrill, T.C. "*The Systematic Identification of Organic Compounds*", 6th ed, Wiley; New York, 1980.

2.12 Waste Minimization Plan

2.12.1 Reduction

By law, the University must have in place and follow a waste minimization plan for chemical hazardous waste. The preferred hierarchy of choice is:

Reduce:	Reduce the quantity of waste produced
Reuse:	Reuse material back into the process
Recycle:	Recycle material on or off site
Dispose:	Dispose or deactivate waste in a safe, lawful manner.

- Reduce quantity of waste produced, either by eliminating or substituting with non-hazardous material, or scaling-back the volumes worked with.
- Clearly mark or label the content of all containers.
- Analyze the waste you generate: is it necessary to generate the waste, and what feasible modifications can you make to the procedures that would result in the elimination or volume reduction of the waste generated.
- Purchase only the amounts of chemicals you know you will use. Buying in bulk may be less expensive initially, but the disposal cost of most surplus chemicals is many times greater than the original purchase costs.
- Maintain a chemical inventory where possible. By knowing what you have on hand and where it is located you may avoid duplicate ordering and expired chemicals.
- Reduce the scale of your experiments (micro scaling). This decreases the amount of chemicals that are required to be purchased, decreases chemical exposure, reduces air pollution from emissions, and reduces the amount of waste generated.
- Increase the use of instrumental analysis as opposed to wet chemistry techniques whenever possible.

2.12.1.1 Substitution

Substitute with non-hazardous or less hazardous materials whenever possible. Some examples of substitution in common laboratory procedures are listed below:

- Phosgene is a highly toxic gas used as a reagent in many organic transformations. Its use requires extensive safety precautions and the disposal of cylinders. Available substitutes include diphosgene, a liquid, or triphosene bis carbonate, a low melting solid. Both can be used by making experimental adjustments, or they can be used to generate phosgene on demand. The two substitutes are also toxic but they avoid the handling of cylinders and toxic gases.
- Heavy metals reagents such as chromic acids used as cleaning solutions for glassware can be replaced by proprietary detergents used in conjunction with ultrasonic baths (e.g., Micro-90).
- Fluorine and fluorinating reagents are among the most demanding of reagents to handle because of their reactivity and toxicity. Less toxic substitutes have been developed such as F-TEDA-B F4.
- Organic solvents for liquid-liquid extraction or chromatography can often be replaced by other solvents with significant benefits. Benzene, once widely used as a solvent, has been satisfactory substituted for by toluene.
- Diethyl-ether is flammable and has a tendency to form explosive peroxides. It can be substituted by methyl-t-butyl-ether. Methyl-t-butyl-ether is also flammable but its use eliminates the need to monitor peroxide formation during handling and storage as it has greatly reduced tendencies to form peroxides.

- Organic solvents for high-performance chromatography can be replaced by supercritical carbon dioxide. While supercritical solvents require specialized equipment for handling, they offer the benefits of large reduction in organic solvent waste.
- Mercury thermometers are easily broken, which results in waste disposal costs and release to the environment. Substitution of alcohol thermometers eliminates these problems. Waste from broken alcohol thermometers can go into a cardboard box that can be disposed of in the regular trash.

If you or your colleagues have an idea for a substitution process, but require funding for evaluation, please contact the OEHS to review a cooperative solution. In addition, if you have implemented a successful substitution, please share with your colleagues and the OEHS.

2.12.2 Reusing Waste Chemicals

- Used solvent from one process may be used for another process that requires a less pure solvent.
- When using solvents for cleaning, reuse solvent for initial cleaning, reserve fresh solvent for final rinse.
- The end product from one experiment can be used as an ingredient for another experiment.
- Another researcher or laboratory may have a beneficial reuse of your waste chemical.

2.12.3 Recycling

- Install solvent distillation units to distill and reuse solvents. (Contact OEHS for safety and environmental concerns before installing unit.)
- To facilitate distillation, solvents intended for recycling should not be mixed with other solvents.
- Batteries and fluorescent light tubes are to be collected for off-site recycling.

2.12.4 Proper Destruction or Disposal

Many chemicals can be deactivated as the final step to a protocol, i.e. neutralization of acidic waste. See Appendix H for deactivation procedures for some common chemicals.

- Do not stockpile chemicals. Excess or outdated chemicals should not be allowed to accumulate and create an unsafe working environment
- Do not abandon chemicals when you leave the University or move to another lab. Label and call in unused chemicals for pick-up by ESS prior to leaving the laboratory. Abandoned materials without labels become unknowns and are costly to dispose of. The Principal Investigator is responsible for oversight of this process.

Section 3 Chemical Waste Management Appendices

3.1 Appendix A - Acute Hazardous Waste ("P" List)

Hazardous Waste No.	Chemical abstracts No.	Substance
P023	107 - 20 - 0	Acetaldehyde, chloro-
P002	591 - 08 - 2	Acetamide, N-(aminothioxomethyl)-
P057	640 - 19 - 7	Acetamide, 2-fluoro-
P058	62 - 74 - 8	Acetic acid, fluoro-, sodium salt
P002	591 - 08 - 2	1-Acetyl-2-thiourea
P003	107 - 02 - 8	Acrolein
P070	116 - 06 - 3	Aldicarb
P203	1646 - 88 - 4	Aldicarb sulfone.
P004	309 - 00 - 2	Aldrin
P005	107 - 18 - 6	Allyl alcohol
P006	20859 - 73 - 8	Aluminum phosphide (R,T)
P007	2763 - 96 - 4	5-(Aminomethyl)-3-isoxazolol
P008	504 - 24 - 5	4-Aminopyridine
P009	131 - 74 - 8	Ammonium picrate (R)
P119	7803 - 55 - 6	Ammonium vanadate
P099	506 - 61 - 6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778 - 39 - 4	Arsenic acid H3AsO4
P012	1327 - 53 - 3	Arsenic oxide As2O3
P011	1303 - 28 - 2	Arsenic oxide As2O5
P011	1303 - 28 - 2	Arsenic pentoxide
P012	1327 - 53 - 3	Arsenic trioxide
P038	692 - 42 - 2	Arsine, diethyl-
P036	696 - 28 - 6	Arsonous dichloride, phenyl-
P054	151 - 56 - 4	Aziridine
P067	75 - 55 - 8	Aziridine, 2-methyl-
P013	542 - 62 - 1	Barium cyanide
P024	106 - 47 - 8	Benzenamine, 4-chloro-
P077	100 - 01 - 6	Benzenamine, 4-nitro-
P028	100 - 44 - 7	Benzene, (chloromethyl)-
P042	51 - 43 - 4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-,(R)-
P046	122 - 09 - 8	Benzeneethanamine, alpha, alpha dimethyl-
P014	108 - 98 - 5	Benzenethiol
P127	1563 - 66 - 2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl, methylcarbamate.
P188	57 - 64 - 7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1, 3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	181 - 81 -2	2H-1-Benzopyran-2-one, 4-hydroxy-3 (3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100 - 44 - 7	Benzyl chloride

Hazardous Waste No.	Chemical abstracts No.	Substance
P015	7440 - 41 - 7	Beryllium powder
P017	598 - 31 - 2	Bromoacetone
P018	357 - 57 - 3	Brucine
P045	39196 - 18 - 4	2-Butanone, 3, 3-dimethyl-1-(methylthio)-, O-methylamino)carbonyl] oxime
P021	592 - 01 - 8	Calcium cyanide
P021	592 - 01 - 8	Calcium cyanide Ca(CN)2
P189	55285 - 14 - 8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644 - 64 - 4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119 - 38 - 0	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129 - 41 - 5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563 - 66 - 2	Carbofuran.
P022	75 - 15 - 0	Carbon disulfide
P095	75 - 44 - 5	Carbonic dichloride
P189	55285 - 14 - 8	Carbosulfan.
P023	107 - 20 - 0	Chloroacetaldehyde
P024	106 - 47 - 8	p-Chloroaniline
P026	5344 - 82 - 1	1-(o-Chlorophenyl)thiourea
P027	542 - 76 - 7	3-Chloropropionitrile
P029	544 - 92 - 3	Copper cyanide
P029	544 - 92 - 3	Copper cyanide Cu(CN)
P202	64 - 00 - 6	m-Cumenyl methylcarbamate.
P030		Cyanides (soluble cyanide salts), not Otherwise specified
P031	460 - 19 - 5	Cyanogen
P033	506 - 77 - 4	Cyanogen chloride
P033	506 - 77 - 4	Cyanogen chloride (CN)Cl
P034	131 - 89 - 5	2-Cyclohexyl-4,6-dinitrophenol
P016	542 - 88 - 1	Dichloromethyl ether
P036	696 - 28 - 6	Dichlorophenylarsine
P037	60 - 57 - 1	Dieldrin
P038	692 - 42 - 2	Diethylarsine
P041	311 - 45 - 5	Diethyl-p-nitrophenyl phosphate
P040	297 - 97 - 2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55 - 91 - 4	Diisopropylfluorophosphate (DFP)(62-

Hazardous Waste No.	Chemical abstracts No.	Substance
P004	309 - 00 - 2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha, 4alpha, 4abeta, 5alpha, 8alpha, 8abeta) P060 465 - 73 - 6 1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10 hexa-chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha, 4alpha, 4abeta, 5beta, 8beta, 8abeta)-
P037	60 - 57 - 1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,(1aalpha, 2beta, 2aalpha, 3beta, 6beta, 6aalpha, 7beta, 7aalpha)-
P051	172 - 20 - 8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha, 2beta, 2abeta, 3alpha, 6alpha, 6abeta, 7beta 7aalpha)-, & metabolites
P044	60 - 51 - 5	Dimethoate
P046	122 - 09 - 8	alpha,alpha-Dimethylphenethylamine
P191	644 - 64 - 4	Dimetilan.
P047	1534 - 52 - 1	4,6-Dinitro-o-cresol, & salts
P048	51 - 28 - 5	2,4-Dinitrophenol
P020	88 - 85 - 7	Dinoseb
P085	152 - 16 - 9	Diphosphoramide, octamethyl-
P111	107 - 49 - 3	Diphosphoric acid, tetraethyl ester
P039	298 - 04 - 4	Disulfoton
P049	541 - 53 - 7	Dithiobiuret
P185	26419 - 73 - 8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)-carbonyl]oxime.
P050	115 - 29 - 7	Endosulfan
P088	145 - 73 - 3	Endothall
P051	72 - 20 - 8	Endrin
P051	72 - 20 - 8	Endrin, & metabolites
P042	51 - 43 - 4	Epinephrine
P031	460 - 19 - 5	Ethanedinitrile
P194	23135 - 22 - 0	Ethanimidothioc acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752 - 77 - 5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107 - 12 - 0	Ethyl cyanide
P054	151 - 56 - 4	Ethyleneimine
P097	52 - 85 - 7	Famphur

Hazardous Waste No.	Chemical abstracts No.	Substance
P056	7782 - 41 - 4	Fluorine
P057	640 - 19 - 7	Fluoroacetamide
P058	62 - 74 - 8	Fluoroacetic acid, sodium salt
P198	23422 - 53 - 9	Formetanate hydrochloride.
P197	17702 - 57 - 7	Formparanate.
P065	628 - 86 - 4	(2+) salt (R,T)
P059	76 - 44 - 8	Heptachlor
P062	757 - 58 - 4	Hexaethyl tetraphosphate
P116	79 - 19 - 6	Hydrazinecarbothioamide
P068	60 - 34 - 4	Hydrazine, methyl-
P063	74 - 90 - 8	Hydrocyanic acid
P063	74 - 90 - 8	Hydrogen cyanide
P096	7803 - 51 - 2	Hydrogen phosphide
P060	465 - 73 - 6	Isodrin
P192	119 - 38 - 0	Isolan.
P202	64 - 00 - 6	3-Isopropylphenyl N-methylcarbamate.
P007	2763 - 96 - 4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339 - 36 - 3	Manganese, bis (dimethylcarbamodithioato-S,S')-,
P196	15339 - 36 - 3	Manganese dimethyldithiocarbamate.
P092	62 - 38 - 4	Mercury, (acetato-O)phenyl-
P065	628 - 86 - 4	Mercury fulminate (R,T)
P082	62 - 75 - 9	Methanamine, N-methyl-N-nitroso-
P064	624 - 83 - 9	Methane, isocyanato-
P016	542 - 88 - 1	Methane, oxybis[chloro-
P112	509 - 14 - 8	Methane, tetranitro- (R)
P118	75 - 70 - 7	Methanethiol, trichloro-
P198	23422 - 53 - 9	Methanimidamide, N,N-dimethyl-N'-[3-[[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702 - 57 - 9	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4-[(methylamino) carbonyl]oxy] phenyl]-
P050	115 - 29 - 7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76 - 44 - 8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P199	2032 - 65 - 7	Methiocarb.
P066	16752 - 77 - 5	Methomyl
P068	60 - 34 - 4	Methyl hydrazine
P064	624 - 83 - 9	Methyl isocyanate
P069	75 - 86 - 5 2-	Methyllactonitrile
P071	298 - 00 - 0	Methyl parathion
P190	1129 - 41 - 5	Metolcarb.(63-
P128	315 - 8 - 4	Mexacarbate.
P072	86 - 88 - 4	alpha-Naphthylthiourea
P073	13463 - 39 - 3	Nickel carbonyl

Hazardous Waste No.	Chemical abstracts No.	Substance
P073	13463 - 39 - 3	Nickel carbonyl Ni(CO)4, (T-4)-
P074	557 - 19 - 7	Nickel cyanide
P074	557 - 19 - 7	Nickel cyanide Ni(CN)2
P075	154 - 11 - 5	Nicotine, & salts
P076	10102 - 43 - 9	Nitric oxide
P077	100 - 01 - 6	p-Nitroaniline
P078	10102 - 44 - 0	Nitrogen dioxide
P076	10102 - 43 - 9	Nitrogen oxide NO
P078	10102 - 44 - 0	Nitrogen oxide NO2
P081	55 - 63 - 0	Nitroglycerine (R)
P082	62 - 75 - 9	-Nitrosodimethylamine
P084	4549 - 40 - 0	N-Nitrosomethylvinylamine
P085	152 - 16 - 9	Octamethylpyrophosphoramide
P087	20816 - 12 - 0	Osmium oxide OsO4, (T-4)-
P087	20816 - 12 - 0	Osmium tetroxide
P088	145 - 73 - 3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P194	23135 - 22 - 0	Oxamyl.
P089	56 - 38 - 2	Parathion
P034	131 - 89 - 5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51 - 28 - 5	Phenol, 2,4-dinitro-
P047	1534 - 52 -1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88 - 85 - 7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009 (R)	131 - 74 - 8	Phenol, 2,4,6-trinitro-, ammonium salt
P128	315 - 18 - 4	Phenol, 4-(dimethylamino)-3,5-dimethyl-,methylcarbamate (ester).
P199	2032 - 65 - 7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P202	64 - 00 - 6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631 - 37 - 0	Phenol, 3-methyl-5-(1-methylethyl)-, Methyl carbamate.
P092	62 - 38 - 4	Phenylmercury acetate
P093	103 - 85 - 5	Phenylthiourea
P094	298 - 02 - 2	Phorate
P095	75 - 44 - 5	Phosgene
P096	7803 - 51 - 2	Phosphine
P041	311 - 45 - 5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298 - 04 - 4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298 - 02 - 2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60 - 51 - 5	Phosphorodithioic acid, O,O-dimethyl S-[2- (methylamino)-2-oxoethyl] ester
P043	55 - 91 - 4	Phosphorofluoridic acid, bis(1-methylethyl) ester

Hazardous Waste No.	Chemical abstracts No.	Substance
P089	56 - 38 - 2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl)ester
P040	297 - 97 - 2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52 - 85 - 7	Phosphorothioic acid, O-[4-[(dimethylamino) sulfonyl]phenyl] O,O-dimethyl ester
P071	298 - 00 - 0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57 - 47 - 6	Physostigmine.
P188	57 - 64 - 7	Physostigmine salicylate.
P110	78 - 00 - 2	Plumbane, tetraethyl-
P098	151 - 50 - 8	Potassium cyanide
P098	151 - 50 - 8	Potassium cyanide K(CN)
P099	506 - 61 - 6	Potassium silver cyanide
P201	2631 - 37 - 0	Promecarb
P070	116 - 06 - 3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646 - 88 - 4	Propanal, 2-methyl-2-(methyl-sulfonyl), O-[(methylamino)carbonyl] oxime.
P101	107 - 12 - 0	Propanenitrile
P027	542 - 76 - 7	Propanenitrile, 3-chloro-
P069	75 - 86 - 5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55 - 63 - 0	1,2,3-Propanetriol, trinitrate (R)
P017	598 - 31 - 2	2-Propanone, 1-bromo-
P102	107 - 19 - 7	Propargyl alcohol
P003	107 - 02 - 8	2-Propenal
P005	107 - 18 - 6	2-Propen-1-ol
P067	75 - 55 - 8	1,2-Propylenimine
P102	107 - 19 - 7	2-Propyn-1-ol
P008	504 - 24 - 5	4-Pyridinamine
P075	154 - 11 - 5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57 - 47 - 6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
P114	12039 - 52 - 0	Selenious acid, dithallium(1+) salt(64-
P103	630 - 10 - 4	Selenourea
P104	506 - 64 - 9	Silver cyanide
P104	506 - 64 - 9	Silver cyanide Ag(CN)
P105	26628 - 22 - 8	Sodium azide
P106	143 - 33 - 9	Sodium cyanide
P106	143 - 33 - 9	Sodium cyanide Na(CN)
P108	157 - 24 - 9	Strychnidin-10-one, & salts
P018	357 - 57 - 3	Strychnidin-10-one, 2,3-dimethoxy-
P108	157 - 24 - 9	Strychnine, & salts
P115	7446 - 18 - 6	Sulfuric acid, dithallium(1+) salt
P109	3689 - 24 - 5	Tetraethyldithiopyrophosphate

Hazardous Waste No.	Chemical abstracts No.	Substance
P110	78 - 00 - 2	Tetraethyl lead
P111	107 - 49 - 3	Tetraethyl pyrophosphate
P112	509 - 14 - 8	Tetranitromethane (R)
P062	757 - 58 - 4	Tetraphosphoric acid, hexaethyl ester
P113	1314 - 32 - 5	Thallic oxide
P113	1314 - 32 - 5	Thallium oxide Tl2O3
P114	12039 - 52 - 0	Thallium(I) selenite
P115	7446 - 18 - 6	Thallium(I) sulfate
P109	3689 - 24 - 5	Thiodiphosphoric acid, tetraethyl ester
P045	39196 - 18 - 4	Thiofanox
P049	541 - 53 - 7	Thioimidodicarbonic diamide [(H2N)C(S)]2NH
P014	108 - 98 - 5	Thiophenol
P116	79 - 19 - 6	Thiosemicarbazide
P026	5344 - 82 - 1	Thiourea, (2-chlorophenyl)-
P072	86 - 88 - 4	Thiourea, 1-naphthalenyl-
P093	103 - 85 - 5	Thiourea, phenyl-
P185	26419 - 73 - 8	Tirpate.
P123	8001 - 35 - 8	Toxaphene
P118	75 - 70 - 7	Trichloromethanethiol
P119	7803 - 55 - 6	Vanadic acid, ammonium salt
P120	1314 - 62 - 1	Vanadium oxide V2O5
P120	1314 - 62 - 1	Vanadium pentoxide
P084	4549 - 40 - 0	Vinylamine, N-methyl-N-nitroso-
P001	181 - 81 - 2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137 - 30 - 4	Zinc, bis(dimethylcarbamodithioato-S,S')-,
P121	557 - 21 - 1	Zinc cyanide
P121	557 - 21 - 1	Zinc cyanide Zn(CN)2
P122	1314 - 84 - 7	Zinc phosphide Zn3P2, when present at concentrations greater than 10% (R,T)
P205	137 - 30 - 4	Ziram.

1CAS Number given for parent compound only

3.2 Appendix B - Toxic Hazardous Waste ("U" Listed Waste)

Hazardous Waste No.	Chemical Abstracts No.	Substance
U394	30558 - 43 - 1	A2213.
U001	75 - 07 - 0	Acetaldehyde (I)
U034	75 - 87 - 6	Acetaldehyde, trichloro-
U187	62 - 44 - 2	Acetamide, N-(4-ethoxyphenyl)-
U005	53 - 96 - 3	Acetamide, N-9H-fluoren-2-yl-
U240	194 - 75 - 7	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
U112	141 - 78 - 6	Acetic acid ethyl ester (I)
U144	301 - 04 - 2	Acetic acid, lead(2+) salt
U214	563 - 68 - 8	Acetic acid, thallium(1+) salt
see F027	93 - 76 - 5	Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67 - 64 - 1	Acetone (I)
U003	75 - 05 - 8	Acetonitrile (I,T)
U004	98 - 86 - 2	Acetophenone
U005	53 - 96 - 3	2-Acetylaminofluorene
U006	75 - 36 - 5	Acetyl chloride (C,R,T)
U007	79 - 06 - 1	Acrylamide
U008	79 - 10 - 7	Acrylic acid (I)
U009	107 - 13 - 1	Acrylonitrile
U011	61 - 82 - 5	Amitrole
U012	62 - 53 - 3	Aniline (I,T)
U136	75 - 60 - 5	Arsinic acid, dimethyl-
U014	492 - 80 - 8	Auramine
U015	115 - 02 - 6	Azaserine
U010	50 - 07 - 7	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8 [[(aminocarbonyl) oxy]methyl]-1, 1a, 2, 8, 8a, 8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta,8aalpha,8balpha)]-
U280	101 - 27 - 9	Barban.
U278	22781 - 23 - 3	Bendiocarb.
U364	22961 - 82 - 6	Bendiocarb phenol.
U271	17804 - 35 - 2	Benomyl.
U157	56 - 49 - 5	Benz[j]aceanthrylene,1,2-dihydro-3 methyl-
U016	225 - 51 - 4	Benz[c]acridine
U017	98 - 87 - 3	Benzal chloride
U192	23950 - 58 - 5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	56 - 55 - 3	Benz[a]anthracene
U094	57 - 97 - 6	Benz[a]anthracene, 7,12-dimethyl-
U012	62 - 53 - 3	Benzenamine (I,T)
U014	492 - 80 - 8	Benzenamine, 4,4'-carbonimidoylbis [N,N-dimethyl-
U049	3165 - 93 - 3	Benzenamine, 4-chloro-2-methyl-, hydrochloride

Hazardous Waste No.	Chemical Abstracts No.	Substance
U093	60 - 11 - 7	Benzenamine, N,N-dimethyl-4-(phenylazo)
U328	95 - 53 - 4	Benzenamine, 2-methyl-
U353	106 - 49 - 0	Benzenamine, 4-methyl-
U158	101 - 14 - 4	Benzenamine, 4,4'-methylenebis[2-chloro-
U222	636 - 21 - 5	Benzenamine, 2-methyl-, hydrochloride
U181	99 - 55 - 8	Benzenamine, 2-methyl-5-nitro-
U019	71 - 43 - 2	Benzene (I,T)
U038	510 - 15 - 6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyester
U030	101 - 55 - 3	Benzene, 1-bromo-4-phenoxy-
U035	305 - 03 - 3	Benzenebutanoic acid, 4-[bis(2-chloroethyl) amino]-
U037	108 - 90 - 7	Benzene, chloro-
U221	25376 - 45 - 8	Benzenediamine, ar-methyl-
U028	117 - 81 - 7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U069	84 - 74 - 2	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	84 - 66 - 2	1,2-Benzenedicarboxylic acid, diethyl ester
U102	131 - 11 - 3	1,2-Benzenedicarboxylic acid, dimethyl ester
U107	117 - 84 - 0	1,2-Benzenedicarboxylic acid, dioctyl ester
U070	95 - 50 - 1	Benzene, 1,2-dichloro-
U071	541 - 73 - 1	Benzene, 1,3-dichloro-
U072	106 - 46 - 7	Benzene, 1,4-dichloro-
U060	72 - 54 - 8	Benzene, 1,1'-(2,2-dichloroethylidene) bis[4-chloro-
U017	98 - 87 - 3	Benzene, (dichloromethyl)-
U223	26471 - 62 - 5	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	1330 - 20 - 7	Benzene, dimethyl- (I,T)
U201	108 - 46 - 3	1,3-Benzenediol
U127	118 - 74 - 1	Benzene, hexachloro-
U056	110 - 82 - 7	Benzene, hexahydro- (I)
U220	108 - 88 - 3	Benzene, methyl-
U105	121 - 14 - 2	Benzene, 1-methyl-2,4-dinitro-
U106	606 - 20 - 2	Benzene, 2-methyl-1,3-dinitro-
U055	98 - 82 - 8	Benzene, (1-methylethyl)- (I)
U169	98 - 95 - 3	Benzene, nitro-
U183	608 - 93 - 5	Benzene, pentachloro-
U185	82 - 68 - 8	Benzene, pentachloronitro-
U020	98 - 09 - 9	Benzenesulfonic acid chloride (C,R)
U020	98 - 09 - 9	Benzenesulfonyl chloride (C,R)
U207	95 - 94 - 3	Benzene, 1,2,4,5-tetrachloro-

Hazardous Waste No.	Chemical Abstracts No.	Substance
U061	50 - 29 - 3	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-
U247	72 - 43 - 5	Benzene, 1,1'-(2,2,2-trichloroethylidene) bis[4-methoxy-
U023	98 - 07 - 7	Benzene, (trichloromethyl)-
U234	99 - 35 - 4	Benzene, 1,3,5-trinitro-
U021	92 - 87 - 5	Benzidine
U202	181 - 07 - 2	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, & salts
U278	22781 - 23 - 3	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate.
U364	22961 - 82 - 6	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,
U203	94 - 59 - 7	1,3-Benzodioxole, 5-(2-propenyl)-
U141	120 - 58 - 1	1,3-Benzodioxole, 5-(1-propenyl)-
U367	1563 - 38 - 8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-
U090	94 - 58 - 6	1,3-Benzodioxole, 5-propyl-
U064	189 - 55 - 9	Benzo[rst]pentaphene
U248	181 - 81 - 2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations of 0.3% or less
U022	50 - 32 - 8	Benzo[a]pyrene
U197	106 - 51 - 4	p-Benzoquinone
U023	98 - 07 - 7	Benzotrichloride (C,R,T)
U085	1464 - 53 - 5	2,2'-Bioxirane
U021	92 - 87 - 5	[1,1'-Biphenyl]-4,4'-diamine
U073	91 - 94 - 1	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-
U091	119 - 90 - 4	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U095	119 - 93 - 7	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U225	75 - 25 - 2	Bromoform
U030	101 - 55 - 3	4-Bromophenyl phenyl ether
U128	87 - 68 - 3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	924 - 16 - 3	1-Butanamine, N-butyl-N-nitroso-
U031	71 - 36 - 3	1-Butanol (I)
U159	78 - 93 - 3	2-Butanone (I,T)
U160	1338 - 23 - 4	2-Butanone, peroxide (R,T)
U053	4170 - 30 - 3	2-Butenal
U074	764 - 41 - 0	2-Butene, 1,4-dichloro- (I,T)
U143	303 - 34 - 4	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy- 2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5,7a-tetrahydro-1H pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*),7aalpha]]-
U031	71 - 36 - 3	n-Butyl alcohol (I)
U136	75 - 60 - 5	Cacodylic acid
U032	13765 - 19 - 0	Calcium chromate

Hazardous Waste No.	Chemical Abstracts No.	Substance
U372	10605 - 21 - 7	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester.
U271	17804 - 35 - 2	Carbamic acid, [1-[(butylamino) carbonyl]-1H-benzimidazol-2-yl]-, methyl ester.
U280	101 - 27 - 9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester.
U238	51 - 79 - 6	Carbamic acid, ethyl ester
U178	615 - 53 - 2	Carbamic acid, methylnitroso-, ethyl ester
U373	122 - 42 - 9	Carbamic acid, phenyl-, 1-methylethyl ester.
U409	23564 - 05 - 8	Carbamic acid, [1,2-phenylenebis (iminocarbonothioyl)]bis-, dimethyl ester.
U097	79 - 44 - 7	Carbamic chloride, dimethyl-
U389	2303 - 17 - 5	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester.
U387	52888 - 80 - 9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester.
U114	1111 - 54 - 6	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U062	2303 - 16 - 4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester
U279	63 - 25 - 2	Carbaryl.
U372	10605 - 21 - 7	Carbendazim.
U367	1563 - 38 - 8	Carbofuran phenol.
U215	6533 - 73 - 9	Carbonic acid, dithallium(1+) salt
U033	353 - 50 - 4	Carbonic difluoride
U156	79 - 22 - 1	Carbonochloridic acid, methyl ester(I,T)
U033	353 - 50 - 4	Carbon oxyfluoride (R,T)
U211	56 - 23 - 5	Carbon tetrachloride
U034	75 - 87 - 6	Chloral
U035	305 - 03 - 3	Chlorambucil
U036	57 - 74 - 9	Chlordane, alpha & gamma isomers
U026	494 - 03 - 1	Chlornaphazin
U037	108 - 90 - 7	Chlorobenzene
U038	510 - 15 - 6	Chlorobenzilate
U039	59 - 50 - 7	p-Chloro-m-cresol
U042	110 - 75 - 8	2-Chloroethyl vinyl ether
U044	67 - 66 - 3	Chloroform
U046	107 - 30 - 2	Chloromethyl methyl ether
U047	91 - 58 - 7	beta-Chloronaphthalene
U048	95 - 57 - 8	o-Chlorophenol
U049	3165 - 93 - 3	-Chloro-o-toluidine, hydrochloride
U032	13765 - 19 - 0	Chromic acid H2CrO4, calcium salt
U050	218 - 01 - 9	Chrysene
U051		Creosote
U052	1319 - 77 - 3	Cresol (Cresylic acid)
U053	4170 - 30 - 3	Crotonaldehyde
U055	98 - 82 - 8	Cumene (I)
U246	506 - 68 - 3	Cyanogen bromide (CN)Br
U197	106 - 51 - 4	2,5-Cyclohexadiene-1,4-dione

Hazardous Waste No.	Chemical Abstracts No.	Substance
U056	110 - 82 - 7	Cyclohexane (I)
U129	58 - 89 - 9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U057	108 - 94 - 1	Cyclohexanone (I)
U130	77 - 47 - 4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	50 - 18 - 0	Cyclophosphamide
U240	194 - 75 - 7	2,4-D, salts & esters
U059	20830 - 81 - 3	Daunomycin
U060	72 - 54 - 8	DDD
U061	50 - 29 - 3	DDT
U062	2303 - 16 - 4	Diallate
U063	53 - 70 - 3	Dibenz[a,h]anthracene
U064	189 - 55 - 9	Dibenzo[a,i]pyrene
U066	96 - 12 - 8	1,2-Dibromo-3-chloropropane
U069	84 - 74 - 2	Dibutyl phthalate
U070	95 - 50 - 1	o-Dichlorobenzene
U071	541 - 73 - 1	m-Dichlorobenzene
U072	106 - 46 - 7	p-Dichlorobenzene
U073	91 - 94 - 1	3,3'-Dichlorobenzidine
U074	764 - 41 - 0	1,4-Dichloro-2-butene (I,T)
U075	75 - 71 - 8	Dichlorodifluoromethane
U078	75 - 35 - 4	1,1-Dichloroethylene
U079	156 - 60 - 5	1,2-Dichloroethylene
U025	111 - 44 - 4	Dichloroethyl ether
U027	108 - 60 - 1	Dichloroisopropyl ether
U024	111 - 91 - 1	Dichloromethoxy ethane
U081	120 - 83 - 2	2,4-Dichlorophenol
U082	87 - 65 - 0	2,6-Dichlorophenol
U084	542 - 75 - 6	1,3-Dichloropropene
U085	1464 - 53 - 5	1,2:3,4-Diepoxybutane (I,T)
U108	123 - 91 - 1	1,4-Diethyleneoxide
U028	117 - 81 - 7	Diethylhexyl phthalate
U395	5952 - 26 - 1	Diethylene glycol, dicarbamate.
U086	1615 - 80 - 1	N,N'-Diethylhydrazine
U087	3288 - 58 - 2	O,O-Diethyl S-methyl dithiophosphate
U088	84 - 66 - 2	Diethyl phthalate
U089	56 - 53 - 1	Diethylstilbesterol
U090	94 - 58 - 6	Dihydrosafrole
U091	119 - 90 - 4	3,3'-Dimethoxybenzidine
U092	124 - 40 - 3	Dimethylamine (I)
U093	60 - 11 - 7	p-Dimethylaminoazobenzene
U094	57 - 97 - 6	7,12-Dimethylbenz[a]anthracene
U095	119 - 93 - 7	3,3'-Dimethylbenzidine
U096	80 - 15 - 9	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U097	79 - 44 - 7	Dimethylcarbamoyl chloride
U098	57 - 14 - 7	1,1-Dimethylhydrazine
U099	540 - 73 - 8	1,2-Dimethylhydrazine
U101	105 - 67 - 9	2,4-Dimethylphenol
U102	131 - 11 - 3	Dimethyl phthalate

Hazardous Waste No.	Chemical Abstracts No.	Substance
U103	77 - 78 - 1	Dimethyl sulfate
U105	121 - 14 - 2	2,4-Dinitrotoluene
U106	606 - 20 - 2	2,6-Dinitrotoluene
U107	117 - 84 - 0	Di-n-octyl phthalate
U108	123 - 91 - 1	1,4-Dioxane
U109	122 - 66 - 7	1,2-Diphenylhydrazine
U110	142 - 84 - 7	Dipropylamine (I)
U111	621 - 64 - 7	Di-n-propylnitrosamine
U041	106 - 89 - 8	Epichlorohydrin
U001	75 - 07 - 0	Ethanal (I)
U404	121 - 44 - 8	Ethanamine, N,N-diethyl-
U174	55 - 18 - 5	Ethanamine, N-ethyl-N-nitroso-
U155	91 - 80 - 5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)
U067	106 - 93 - 4	Ethane, 1,2-dibromo-
U076	75 - 34 - 3	Ethane, 1,1-dichloro-
U077	107 - 06 - 2	Ethane, 1,2-dichloro-
U131	67 - 72 - 1	Ethane, hexachloro-
U024	111 - 91 - 1	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-
U117	60 - 29 - 7	Ethane, 1,1'-oxybis-(I)
U025	111 - 44 - 4	Ethane, 1,1'-oxybis[2-chloro-
U184	76 - 01 - 7	Ethane, pentachloro-
U208	630 - 20 - 6	Ethane, 1,1,1,2-tetrachloro-
U209	79 - 34 - 5	Ethane, 1,1,2,2-tetrachloro-
U218	62 - 55 - 5	Ethanethioamide
U226	71 - 55 - 6	Ethane, 1,1,1-trichloro-
U227	79 - 00 - 5	Ethane, 1,1,2-trichloro-
U410	59669 - 26 - 0	Ethanimidothioic acid, N,N'[thiobis[(methylimino)carbonyloxy]]bis-, dimethyl ester
U394	30558 - 43 - 1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester.
U359	110 - 80 - 5	Ethanol, 2-ethoxy-
U173	1116 - 54 - 7	Ethanol, 2,2'-(nitrosoimino)bis-
U395	5952 - 26 - 1	Ethanol, 2,2'-oxybis-, dicarbamate.
U004	98 - 86 - 2	Ethanone, 1-phenyl-
U043	75 - 01 - 4	Ethene, chloro-
U042	110 - 75 - 8	Ethene, (2-chloroethoxy)-
U078	75 - 35 - 4	Ethene, 1,1-dichloro-
U079	156 - 60 - 5	Ethene, 1,2-dichloro-, (E)-
U210	127 - 18 - 4	Ethene, tetrachloro-
U228	79 - 01 - 6	Ethene, trichloro-
U112	141 - 78 - 6	Ethyl acetate (I)
U113	140 - 88 - 5	Ethyl acrylate (I)
U238	51 - 79 - 6	Ethyl carbamate (urethane)
U117	60 - 29 - 7	Ethyl ether (I)
U114	1111 - 54 - 6	Ethylenebisdithiocarbamic acid, salts & esters
U067	106 - 93 - 4	Ethylene dibromide
U077	107 - 06 - 2	Ethylene dichloride

Hazardous Waste No.	Chemical Abstracts No.	Substance
U359	110 - 80 - 5	Ethylene glycol monoethyl ether
U115	75 - 21 - 8	Ethylene oxide (I,T)
U116	96 - 45 - 7	Ethylenethiourea
U076	75 - 34 - 3	Ethylidene dichloride
U118	97 - 63 - 2	Ethyl methacrylate
U119	62 - 50 - 0	Ethyl methanesulfonate
U120	206 - 44 - 0	Fluoranthene
U122	50 - 00 - 0	Formaldehyde
U123	64 - 18 - 6	Formic acid (C,T)
U124	110 - 00 - 9	Furan (I)
U125	98 - 01 - 1	2-Furancarboxaldehyde (I)
U147	108 - 31 - 6	2,5-Furandione
U213	109 - 99 - 9	Furan, tetrahydro-(I)
U125	98 - 01 - 1	Furfural (I)
U124	110 - 00 - 9	Furfuran (I)
U206	18883 - 66 - 4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-, D-
U206	18883 - 66 - 4	D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-
U126	765 - 34 - 4	Glycidylaldehyde
U163	70 - 25 - 7	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	118 - 74 - 1	Hexachlorobenzene
U128	87 - 68 - 3	Hexachlorobutadiene
U130	77 - 47 - 4	Hexachlorocyclopentadiene
U131	67 - 72 - 1	Hexachloroethane
U132	70 - 30 - 4	Hexachlorophene
U243	1888 - 71 - 7	Hexachloropropene
U133	302 - 01 - 2	Hydrazine (R,T)
U086	1615 - 80 - 1	Hydrazine, 1,2-diethyl-
U098	57 - 14 - 7	Hydrazine, 1,1-dimethyl-
U099	540 - 73 - 8	Hydrazine, 1,2-dimethyl-
U109	122 - 66 - 7	Hydrazine, 1,2-diphenyl-
U134	7664 - 39 - 3	Hydrofluoric acid (C,T)
U134	7664 - 39 - 3	Hydrogen fluoride (C,T)
U135	7783 - 06 - 4	Hydrogen sulfide
U135	7783 - 06 - 4	Hydrogen sulfide H2S
U096	80 - 15 - 9	Hydroperoxide, 1-methyl-1-phenylethyl- (R)
U116	96 - 45 - 7	2-Imidazolidinethione
U137	193 - 39 - 5	Indeno[1,2,3-cd]pyrene
U190	85 - 44 - 9	1,3-Isobenzofurandione
U140	78 - 83 - 1	Isobutyl alcohol (I,T)
U141	120 - 58 - 1	Isosafrole
U142	143 - 50 - 0	Kepone
U143	303 - 34 - 4	Lasiocarpine
U144	301 - 04 - 2	Lead acetate
U146	1335 - 32 - 6	Lead, bis(acetato-O)tetrahydroxytri-
U145	7446 - 27 - 7	Lead phosphate
U146	1335 - 32 - 6	Lead subacetate
U129	58 - 89 - 9	Lindane

Hazardous Waste No.	Chemical Abstracts No.	Substance
U163	70 - 25 - 7	MNNG
U147	108 - 31 - 6	Maleic anhydride
U148	123 - 33 - 1	Maleic hydrazide
U149	109 - 77 - 3	Malononitrile
U150	148 - 82 - 3	Melphalan
U151	7439 - 97 - 6	Mercury
U152	126 - 98 - 7	Methacrylonitrile (I, T)
U092	124 - 40 - 3	Methanamine, N-methyl- (I)
U029	74 - 83 - 9	Methane, bromo-
U045	74 - 87 - 3	Methane, chloro- (I, T)
U046	107 - 30 - 2	Methane, chloromethoxy-
U068	74 - 95 - 3	Methane, dibromo-
U080	75 - 09 - 2	Methane, dichloro-
U075	75 - 71 - 8	Methane, dichlorodifluoro-
U138	74 - 88 - 4	Methane, iodo-
U119	62 - 50 - 0	Methanesulfonic acid, ethyl ester
U211	56 - 23 - 5	Methane, tetrachloro-
U153	74 - 93 - 1	Methanethiol (I, T)
U225	75 - 25 - 2	Methane, tribromo-
U044	67 - 66 - 3	Methane, trichloro-
U121	75 - 69 - 4	Methane, trichlorofluoro-
U036	57 - 74 - 9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U154	67 - 56 - 1	Methanol (I)
U155	91 - 80 - 5	Methapyrilene
U142	143 - 50 - 0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-
U247	72 - 43 - 5	Methoxychlor
U154	67 - 56 - 1	Methyl alcohol (I)
U029	74 - 83 - 9	Methyl bromide
U186	504 - 60 - 9	1-Methylbutadiene (I)
U045	74 - 87 - 3	Methyl chloride (I,T)
U156	79 - 22 - 1	Methyl chlorocarbonate (I,T)
U226	71 - 55 - 6	Methyl chloroform
U157	56 - 49 - 5	3-Methylcholanthrene
U158	101 - 14 - 4	4,4'-Methylenebis(2-chloroaniline)
U068	74 - 95 - 3	Methylene bromide
U080	75 - 09 - 2	Methylene chloride
U159	78 - 93 - 3	Methyl ethyl ketone (MEK) (I,T)
U160	1338 - 23 - 4	Methyl ethyl ketone peroxide (R,T)
U138	74 - 88 - 4	Methyl iodide
U161	108 - 10 - 1	Methyl isobutyl ketone (I)
U162	80 - 62 - 6	Methyl methacrylate (I,T)
U161	108 - 10 - 1	4-Methyl-2-pentanone (I)
U164	56 - 04 - 2	Methylthiouracil
U010	50 - 07 - 7	Mitomycin C

Hazardous Waste No.	Chemical Abstracts No.	Substance
U059	20830 - 81 - 3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
U167	134 - 32 - 7	1-Naphthalenamine
U168	91 - 59 - 8	2-Naphthalenamine
U026	494 - 03 - 1	Naphthalenamine, N,N'-bis(2-chloroethyl)-
U165	91 - 20 - 3	Naphthalene
U047	91 - 58 - 7	Naphthalene, 2-chloro-
U166	130 - 15 - 4	1,4-Naphthalenedione
U236	72 - 57 - 1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)bis[5-amino-4-hydroxy]-, tetrasodium salt
U279	63 - 25 - 2	1-Naphthalenol, methylcarbamate.
U166	130 - 15 - 4	1,4-Naphthoquinone
U167	134 - 32 - 7	alpha-Naphthylamine
U168	91 - 59 - 8	beta-Naphthylamine
U217	10102 - 45 - 1	Nitric acid, thallium(1+) salt
U169	98 - 95 - 3	Nitrobenzene (I,T)
U170	100 - 02 - 7	p-Nitrophenol
U171	79 - 46 - 9	2-Nitropropane (I,T)
U172	924 - 16 - 3	N-Nitrosodi-n-butylamine
U173	1116 - 54 - 7	N-Nitrosodiethanolamine
U174	55 - 18 - 5	N-Nitrosodiethylamine
U176	759 - 73 - 9	N-Nitroso-N-ethylurea
U177	684 - 93 - 5	N-Nitroso-N-methylurea
U178	615 - 53 - 2	N-Nitroso-N-methylurethane
U179	100 - 75 - 4	N-Nitrosopiperidine
U180	930 - 55 - 2	N-Nitrosopyrrolidine
U181	99 - 55 - 8	5-Nitro-o-toluidine
U193	1120 - 71 - 4	1,2-Oxathiolane, 2,2-dioxide
U058	50 - 18 - 0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U115	75 - 21 - 8	Oxirane (I,T)
U126	765 - 34 - 4	Oxiranecarboxyaldehyde
U041	106 - 89 - 8	Oxirane, (chloromethyl)-2
U183	608 - 93 - 5	Pentachlorobenzene
U184	76 - 01 - 7	Pentachloroethane
U185	82 - 68 - 8	Pentachloronitrobenzene (PCNB)
See F027	87 - 86 - 5	Pentachlorophenol
U161	108 - 10 - 1	Pentanol, 4-methyl-
U186	504 - 60 - 9	1,3-Pentadiene (I)
U187	62 - 44 - 2	Phenacetin
U188	108 - 95 - 2	Phenol
U048	95 - 57 - 8	Phenol, 2-chloro-
U039	59 - 50 - 7	Phenol, 4-chloro-3-methyl-
U081	120 - 83 - 2	Phenol, 2,4-dichloro-
U082	87 - 65 - 0	Phenol, 2,6-dichloro-

Hazardous Waste No.	Chemical Abstracts No.	Substance
U089	56 - 53 - 1	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-,(E)-
U101	105 - 67 - 9	Phenol, 2,4-dimethyl-
U052	1319 - 77 - 3	Phenol, methyl-
U132	70 - 30 - 4	Phenol, 2,2'-methylenebis[3,4,6-trichloro-
U411	114 - 26 - 1	Phenol, 2-(1-methylethoxy)-, methylcarbamate.
U170	100 - 02 - 7	Phenol, 4-nitro-
See F027	87 - 86 - 5	Phenol, pentachloro-
See F027	58 - 90 - 2	Phenol, 2,3,4,6-tetrachloro-
See F027	95 - 95 - 4	Phenol, 2,4,5-trichloro-
See F027	88 - 06 - 2	Phenol, 2,4,6-trichloro-
U150	148 - 82 - 3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-
U145	7446 - 27 - 7	Phosphoric acid, lead(2+) salt (2:3)
U087	3288 - 58 - 2	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U189	1314 - 80 - 3	Phosphorus sulfide (R)
U190	85 - 44 - 9	Phthalic anhydride
U191	109 - 06 - 8	2-Picoline
U179	100 - 75 - 4	Piperidine, 1-nitroso-
U192	23950 - 58 - 5	Pronamide
U194	107 - 10 - 8	1-Propanamine (I,T)
U111	621 - 64 - 7	1-Propanamine, N-nitroso-N-propyl-
U110	142 - 84 - 7	1-Propanamine, N-propyl- (I)
U066	96 - 12 - 8	Propane, 1,2-dibromo-3-chloro-
U083	78 - 87 - 5	Propane, 1,2-dichloro-
U149	109 - 77 - 3	Propanedinitrile
U171	79 - 46 - 9	Propane, 2-nitro- (I,T)
U027	108 - 60 - 1	Propane, 2,2'-oxybis[2-chloro-
U193	1120 - 71 - 4	1,3-Propane sultone
See F027	93 - 72 - 1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-
U235	126 - 72 - 7	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	78 - 83 - 1	1-Propanol, 2-methyl- (I,T)
U002	67 - 64 - 1	2-Propanone (I)
U007	79 - 06 - 1	2-Propenamide
U084	542 - 75 - 6	1-Propene, 1,3-dichloro-
U243	1888 - 71 - 7	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	107 - 13 - 1	2-Propenenitrile
U152	126 - 98 - 7	2-Propenenitrile, 2-methyl- (I,T)
U008	79 - 10 - 7	2-Propenoic acid (I)
U113	140 - 88 - 5	2-Propenoic acid, ethyl ester (I)
U118	97 - 63 - 2	2-Propenoic acid, 2-methyl-, ethyl ester
U162	80 - 62 - 6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U373	122 - 42 - 9	Propham.
U411	114 - 26 - 1	Propoxur.
U387	52888 - 80 - 9	Prosulfocarb.
U194	107 - 10 - 8	n-Propylamine (I,T)(71-
U083	78 - 87 - 5	Propylene dichloride
U148	123 - 33 - 1	3,6-Pyridazinedione, 1,2-dihydro-
U196	110 - 86 - 1	Pyridine
U191	109 - 06 - 8	Pyridine, 2-methyl-

Hazardous Waste No.	Chemical Abstracts No.	Substance
U237	66 - 75 - 1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U164	56 - 04 - 2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	930 - 55 - 2	Pyrrolidine, 1-nitroso-
U200	50 - 55 - 5	Reserpine
U201	108 - 46 - 3	Resorcinol
U202	181 - 07 - 2	Saccharin, & salts
U203	94 - 59 - 7	Safrole
U204	7783 - 00 - 8	Selenium dioxide
U205	7488 - 56 - 4	Selenium sulfide
U205	7488 - 56 - 4	Selenium sulfide SeS2 (R,T)
U015	115 - 02 - 6	L-Serine, diazoacetate (ester)
See F027	93 - 72 - 1	Silvex (2,4,5-TP)
U206	18883 - 66 - 4	Streptozotocin
U103	77 - 78 - 1	Sulfuric acid, dimethyl ester
U189	1314 - 80 - 3	Sulfur phosphide (R)
See F027	93 - 76 - 5	2,4,5-T
U207	95 - 94 - 3	1,2,4,5-Tetrachlorobenzene
U208	630 - 20 - 6	1,1,1,2-Tetrachloroethane
U209	79 - 34 - 5	1,1,2,2-Tetrachloroethane
U210	127 - 18 - 4	Tetrachloroethylene
See F027	58 - 90 - 2	2,3,4,6-Tetrachlorophenol
U213	109 - 99 - 9	Tetrahydrofuran (I)
U214	563 - 68 - 8	Thallium(I) acetate
U215	6533 - 73 - 9	Thallium(I) carbonate
U216	7791 - 12 - 0	Thallium(I) chloride
U216	7791 - 12 - 0	Thallium chloride Tlcl
U217	10102 - 45 - 1	Thallium(I) nitrate
U218	62 - 55 - 5	Thioacetamide
U410	59669 - 26 - 0	Thiodicarb.
U153	74 - 93 - 1	Thiomethanol (I,T)
U244	137 - 26 - 8	Thioperoxydicarbonic diamide [(H2N)C(S)]2S2, tetramethyl-
U409	23564 - 05 - 8	Thiophanate-methyl.
U219	62 - 56 - 6	Thiourea
U244	137 - 26 - 8	Thiram
U220	108 - 88 - 3	Toluene
U221	25376 - 45 - 8	Toluenediamine
U223	26471 - 62 - 5	Toluene diisocyanate (R,T)
U328	95 - 53 - 4	o-Toluidine
U353	106 - 49 - 0	p-Toluidine
U222	636 - 21 - 5	o-Toluidine hydrochloride
U389	2303 - 17 - 5	Triallate.
U011	61 - 82 - 5	1H-1,2,4-Triazol-3-amine
U227	79 - 00 - 5	1,1,2-Trichloroethane
U228	79 - 01 - 6	Trichloroethylene
U121	75 - 69 - 4	Trichloromonofluoromethane
See F027	95 - 95 - 4	2,4,5-Trichlorophenol

Hazardous Waste No.	Chemical Abstracts No.	Substance
See F027	88 - 06 - 2	2,4,6-Trichlorophenol
U404	121 - 44 - 8	Triethylamine.
U234	99 - 35 - 4	1,3,5-Trinitrobenzene (R,T)
U182	123 - 63 - 7	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	126 - 72 - 7	Tris(2,3-dibromopropyl) phosphate
U236	72 - 57 - 1	Trypan blue
U237	66 - 75 - 1	Uracil mustard
U176	759 - 73 - 9	Urea, N-ethyl-N-nitroso-
U177	684 - 93 - 5	Urea, N-methyl-N-nitroso-
U043	75 - 01 - 4	Vinyl chloride
U248	181 - 81 - 2	Warfarin, & salts, when present at concentrations of 0.3% or less
U239	1330 - 20 - 7	Xylene (I)
U200	50 - 55 - 5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methylester,(3beta,16beta,17alpha,18beta,20alpha)-(72-
U249	1314 - 84 - 7	Zinc phosphide Zn3P2, when present at concentration of 10% or less

1CAS Number given for parent compound only.

3.3 Appendix C - "F" Listed Hazardous Waste (Abbreviated List Applicable to University)

EPA hazardous waste No.	
Generic:	
F001.	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1- trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002.	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,11-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003.	The following spent non-halogenated solvents: Xylene, acetone, ethylacetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butylalcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing before use, one or more of the above non-halogenated solvents and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004.	The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005.	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non- halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

3.4 Appendix D - Chemical Disposal Request Fax Form

CHEMICAL WASTE PICK UP REQUEST Date: _____

Environmental Services Section **FAX to 432-6148**

Office of Environmental Health and Safety For additional information on medical, chemical, or radioactive

Telephone: 785-3551 waste, check the OEHS website at www.yale.edu/oehs/

Principal Investigator _____ Building and Room No. _____

Laboratory Contact _____ Contact Phone Number _____

Number of Containers* _____ Size of Containers _____

Chemical Name (not listed below: _____

Chemical Name	Chemical Name	Chemical Name
□ 2-mercaptoethanol	□ Dinitrophenylhydrazine	□ Methylbutane
□ Acetic Acid	□ Dioxane	□ Methylene Chloride
□ Acetone	□ Dioxin	□ Ninhydrin
□ Acetonitrile	□ Epon Epoxy	□ Nitric Acid
□ Acrylamide	□ Ethanol	□ Nitrocellulose
□ Allyl Alcohol	□ Ethanolamine	□ Oil
□ Ammonia	□ Ether	□ Osmium Tetroxide
□ Ammonium Hydroxide	□ Ethidium Bromide	□ Pallodion
□ Amyl Acetate	□ Ethyl Acetate	□ Paraformaldehyde
□ Batteries	□ Ethylenediamine	□ Perchloric Acid
□ Benzaldehyde	□ Ethylene Glycol	□ Petroleum Ether
□ Benzene	□ Fixer	□ Phenol
□ Bromoacetic Acid	□ Formaldehyde	□ Phosphoric Acid
□ Butanol	□ Formalin	□ Piperdine
□ Butyl Acetate	□ Formic Acid	□ Potassium Hydroxide
□ Cacodylate	□ Glutaraldehyde	□ Potassium Metal
□ Carbon Tetrachloride	□ Heptane	□ Potassium Permanganate
□ Cesium Chloride	□ Hexane	□ Pyridine
□ Chloroform	□ Hydrazine	□ Selenium
□ Chromic Acid	□ Hydrochloric Acid	□ Sodium Azide
□ Cupric Sulfate	□ Hydrofluoric Acid	□ Sodium Metal
□ Cyanide	□ Hydrogen Peroxide	□ Sulfuric Acid
□ Cyclohexane	□ Isoamyl Alcohol	□ Tetrahydrofuran
□ DAB – Diaminobenzidine	□ Isopropanol	□ Toluene
□ Developer	□ Mercuric Compounds	□ Trichloroacetic Acid
□ Dimethyldichlorosilane	□ Mercury	□ Trichloroethylene
□ Dimethyl Formamide	□ Methane Sulfonic Acid	□ Triethanolamine
□ Dimethyl Sulfoxide	□ Methanol	□ Xylene

* Each container must have a complete waste tag prior to pick up

COMMENTS _____

_____

_____

□ Door locked, see _____ in room _____ to get key for room _____

□ Please deliver: □ Trays for secondary containment □ 20L (5 gal) carboy containers for solvent waste only

□ Additional hazard – May form peroxides

□ Additional hazard – Air or water reactive

□ Additional hazard – _____

3.5 Appendix E - Chemicals Generally Acceptable for Disposal as Regular Trash

Acacia powder, gum arabic
Acid, Ascorbic
Acid, Benzoic
Acid, Boric
Acid, Casamind
Acid, Citric
Acid, Lactic
Acid, Oleic
Acid, Phthalic
Acid, Salicycle
Acid, Silicic
Acid, Stearic
Acid, Succinic
Acid, Tartaric
Acrylamide gels
Agar(s) and agarose gels
Albumen
Alumina
Aluminum oxide
Amino acids, naturally occurring
Ammonium bicarbonate
Ammonium phosphate
Ammonium sulfate
Ammonium sulfamate
Base, blood agar
Beef extract
Behenic acid
Bentonite
Brain heart infusion
Bromphenol blue
Broth, nutrient
Calcium carbonate
Calcium chloride
Calcium lactate
Calcium oxalate
Calcium phosphate
Calcium silicate
Calcium sulfate
Detergent (most)
Cation exchange resins
Chromatographic absorbents
Crystal violet
Dextrin
Dextrose
Diatomaceous earth
Docosanoic acid
Drierite (calcium sulfate, anhydrous)
Ferric oxide
Ferric phosphate
Ferric pyrophosphate
Ferric sulfate
Ferrous ammonium sulfate
Galactose
Geletin
Gum arabic
Gum guaiac
Hexadecanol, 1-
Kaolin
Lactose
Lanolin
Lauric acid
Lauryl sulfate
Lithium carbonate
Lithium chloride
Lithium sulfate
Litmus
Magnesium carbonate
Magnesium carbonate
Magnesium chloride
Magnesium oxide
Magnesium sulfate
Maltose
Manganese acetate
Manganese chloride
Manganese sulfate
Methyl red
Methyl salicylate
Methylene blue
Methyl stearate
Nutrient agar
Octacosane
Parafin
Pepsin
Peptone
Petroleum jelly
Polyethylene, solid
Polystryrene
Potassium acetate
Potassium bicarbonate
Potassium bromide
Potassium carbonate
Potassium chloride
Potassium citrate
Potassium ferricyanide
Potassium iodide
Potassium phosphate
Potassium sodium tartrate
Potassium sulfate
Potassium sulfite
Potassium sulfocyanate
Pumice
Salts, naturally occurring
Sand
Silica
Silica gel, unused
Silica sand, unused
Silicic acid
Silicon carbide
Sodium acetate
Sodium ammonium phosphate
Sodium benzoate
Sodium bicarbonate
Sodium borate
Sodium bromide
Sodium carbonate
Sodium chloride
Sodium citrate
Sodium dodecyl sulfate (SDS)
Sodium formate
Sodium iodide
Sodium lactate
Sodium phosphate
Sodium phorophosphate
Sodium salicylate
Sodium stearate
Sodium succinate
Sodium sulfate
Sodium sulfite
Sodium tartrate
Sodium thioglycollate
Sodium thiosulfate
Sodium tungstate
Starch
Stearic acid
Stearyl alcohol
Stearylamine, solid
Sucrose
Sugars
Sulfur
Talcum powder
Tetrahydrofurfuryl palmitate
Thymol
Tin metal
Tristearin
Trypticase
Trytone
Urea
Wax, bee's

3.6 Appendix F - Chemicals Generally Acceptable for Sanitary Sewer Disposal

Sanitary Sewer Disposal of Laboratory Chemicals

Some chemicals that are neither Connecticut regulated nor hazardous wastes, and that are either simple inorganic salts or organic materials readily digestible by the microorganisms in a water treatment plant, can generally be disposed of down the drain in limited quantities. The Federal EPA and the New Haven Water Pollution Control Authority regulate what can be disposed of through the sanitary sewer system. The Connecticut Department of Environmental Protection is in the process of drafting a water discharge permit that will limit what can be disposed of in this manner from laboratories. The following guidelines for drain disposal of chemical wastes are based on the exiting regulations and on procedures outlined in the National Research Council publication "*Prudent Practices for Disposal of Chemicals from Laboratories*", (National Academy Press, Washington D.C, 1983) and "*Prudent Practices for Handling of Hazardous Chemicals in Laboratories*", (National Academy Press, Washington D.C, 1995). If you have questions regarding sewer disposal of a laboratory chemical, contact the Environmental Services Section of the Office of Environmental Health and Safety.

Materials discharged to a laboratory drain on campus enters the New Haven Water Pollution Control Authority's sanitary sewer system where it is mixed with sewage and wastewater from area households and businesses and flows to the East Shore Parkway Waste Water Treatment Facility. At the waste treatment plant the waste is subjected to bacterial degradation. Non-degradable chemicals, such as metals, are adsorbed in the sludge or potentially discharged to surface waters. The drain disposal guidelines outlined below must be followed to prevent toxic concentrations of metals or organic compounds from reaching surface waters, accumulating in the sludge, or disrupting the sewage treatment process.

Note: The following materials should <u>NEVER</u> be disposed of through the sanitary sewer system.

- Any waste chemical that meets the EPA's criteria for being hazardous, either as a listed or characteristic waste.
- Oil, grease, or other water insoluble chemicals
- Materials that are not biodegradable or would pass through the sewage treatment plant into the New Haven harbor and be toxic to aquatic organisms or accumulate in harbor sediments.
- Flammable and combustible solvents (flashpoints less then 140^{o}F) (unless sufficiently diluted in water as part of the laboratory process such that the solution has a flashpoint greater than 140^{o}F)
- Discharges with a pH below 5.5 or higher than 9.5
- Materials that could interfere with the biological processes of sewage treatment or would contaminate the sludge-making disposal through the normal methods difficult or impossible.
- All compounds that could result in the presence of toxic gases or vapors within the POTW in a quantity that may cause acute worker health and safety problems
- Malodorous compounds or volatile organic chemicals that can escape from the plumbing system (such as dry traps) causing exposures or obnoxious odors (such as mercaptans or thiols).
- Metallic ions and salts of the heavy metals in solutions or suspension in concentrations exceeding the following:

Element	Concentration (Mg/l)
Arsenic	0.05 (WPCA)
Barium	5.0 (WPCA)
Boron	5.0 (WPCA)
Cadmium	0.1 (WPCA)
Chromium	1.0 (WPCA)
Copper	1.0 (WPCA)
Cyanide	0.1 (WPCA)
Lead	0.1 (WPCA)
Manganese	1.0 (WPCA)
Mercury	0.01 (WPCA)
Nickel	1.0 (WPCA)
Selenium	0.02 (WPCA)
Silver	0.1 (WPCA)
Zinc	1.0 (WPCA)

- Organic compounds in solutions or suspension in concentrations exceeding the following:

Element	Concentration (Mg/l)
Benzene	0.5 (EPA)
Carbon tetrachloride	0.5 (EPA)
Chlorobenzene	100 (EPA)
Chloroform	100 (EPA)
Cresol (or total of o-, m- and p-Cresol)	200 (EPA)
1,4-Dichlorobenzene	7.5 (EPA)
1,2-Dichloroethane	0.5 (EPA)
1,1-Dichloroethylene	0.7 (EPA)
2,4-Dinitrotoluene	0.13 (EPA)
Hexachlorobenzene	0.013 (EPA)
Hexachlorobutadiene	0.5 (EPA)
Hexachloroethane	3.0 (EPA)
Methyl ethyl ketone	200 (EPA)
Nitrobenzene	2.0 (EPA)
Pentachlorophenol	100 (EPA)
Pyridine	5.0 (EPA)
Tetrachloroethylene	0.7 (EPA)
Toxaphene	0.5 (EPA)
Trichloroethylene	0.5 (EPA)
2,4,5-Trichlorophenol	400 (EPA)
2,4,6-Trichlorophenol	2.0 (EPA)
Vinyl chloride	0.2 (EPA)

- Pesticides in solutions or suspension in concentrations exceeding the following:

Element	Concentration (Mg/l)
Chlordane	0.3 (EPA)
2,4-D	10.0 (EPA)
Endrin	0.02 (EPA)
Heptachlor (and its epoxide)	0.008 (EPA)
Lindane	0.4 (EPA)
Methoxychlor	10.0 (EPA)
2,4,5-TP (Silvex)	1.0 (EPA)

Materials that may be disposed of through the sanitary sewer system.

Materials appropriate for sewer disposal in limited quantities must meet the following criteria:

- They are liquids and readily water soluble (at least 3%)
- Easily biodegradable or amenable to treatment by the waste water treatment process
- Are simple salt solutions of low toxicity inorganic substances

Chemicals that can be safely disposed of down the drain include biological compounds and cellular constituents such as proteins, nucleic acids, carbohydrates, sugars, amino acids amines, surfactants and many metabolic intermediates. Other compounds include soluble salt combinations of low toxicity ions and dilute (less then 10%) aqueous solutions of low molecular weight biodegradable organic chemicals such as alcohols, aldehydes, ketones, amines, ethers, cellosolves, nitriles, esters and nitroalkanes. Examples of materials in these categories include:

Soluble salt combinations of the following ions:

Cautions	Anions
Aluminum (Al^{3+})	Bicarbonate (HCO_3^-)
Ammonium (NH_4^+)	Bisulfite (HSO_3^-)
Calcium (Ca^{2+})	Bromate (BrO_3^-)
Cesium (Cs^+)	Bromide (Br^-)
Hydrogen (H^+)	Carbonate (CO_3^{2-})
Lithium (Li^+)	Chlorate (ClO_3^-)
Magnesium (Mg^{2+})	Chloride (Cl^-)
Potassium (K^+)	Hydroxide (HO^-)
Sodium (Na^+)	Iodate (IO_3^-)
Strontium (Sr^{2+})	Iodide (I^-)
Tin (Sn^{2+})	Nitrate PO_4^{3-})
	Nitrite NO_2^-)
	Oxide (O_2^-)
	Phosphate (PO_4^{3-})
	Sulfate (SO_4^{2-})
	Sulfite (SO_3^{2-})

Note: Before discharging into sewer make sure that all other criteria (such as pH, flammability, toxicity, etc. limits) are met.

Dilute (<5%) aqueous solutions of low molecular weight biodegradable organic chemicals appropriate for sanitary sewer discharge include:

Alcohols
Alkanols with fewer than 5 atoms
Alkanediols with fewer than 8 atoms
Sugars and sugar alcohols
Alkoxyalk anols with fewer than 7 carbon atoms
butanol, 1-(*n*- butyl alcohol)
butanol, 2- (sec- butyl alcohol)
ethanol
ethanol,2- (2-butoxyethoxy)
ethylene glycol
glycerol
methyl 1-propanol, 2- (isobutyl alcohol)
methyl 2- butanol, 2- (t-amyl alcohol)
methyl 2-propanol, 2- (*tert* - butyl alcohol)
propanol, 1- (*n* - propyl alcohol)
propanol, 2- (isopropyl alcohol)

Aldehydes
Aliphatic aldehydes with fewer than 5 carbon atoms
butyraldehyde
gluteraldehyde
propionaldehyde

Amides
RCONH2 and RCONHR with fewer than 5 carbon atoms
RCONR2 with fewer than 11 carbon atoms
formamide
propionamide
methylpropionamide, N-
butanamide

Amines**
Aliphatic amines with fewer than 7 carbon atoms
Aliphatic diamines with fewer than 7 carbon atoms
benzylamine
butylamine, N-

Carboxylic Acids**
Alkanoic acids with fewer than 6 carbon atoms
Alkanedioic acids with fewer than 6 carbon atoms
Hydroxyalkanoic acids with fewer than 6 carbon atoms
Aminoalkanoic acids with fewer than 7 carbon atoms
Ammonium, Sodium, and Potassium salts of the above acid classes with fewer than 21 carbon atoms
acetic acid
citric acid
oxalic acid
potassium binoxalate
propanoic acid
sodium acetate
sodium citrate

Esters
Esters with fewer than 5 carbon atoms
isopropyl acetate
methyl acetate
methyl formate
methyl propionate
propyl formate, n-

Ethers
dioxolane

Ketones:
Ketones with fewer than 6 carbon atoms
pentanone, 2-

Nitriles:
propionitrile

Sulfonic Acids:
Sodium or potassium salts of most are acceptable

Note: Before discharging any of these materials into sewer make sure that all other criteria (such as pH limits and flammability) are met.

When discharging waste to the sanitary sewer, you should:

- Never dispose of anything that might lead to a storm sewer rather than a sanitary sewer.
- Use a sink that does not have a history of clogging or overflowing.
- Use a sink in your laboratory, preferably in a hood.
- Flush with at least 10-20 fold excess of water after drain disposal to thoroughly rinse out the sink and sink trap, and to dilute the waste.
- Limit the quantities being discharged to 100 grams of solute per laboratory per day.
- Wear gloves, eye protection and a laboratory coat.
- Inactivate biological materials (e.g., autoclave or bleach-treat) before releasing to sewer.

Hazardous Waste
Satellite Accumulation Area*

Storage Requirements:

- **Containers:**
  - **must be capped** at all times except during transfers.
  - **be compatible** with contents.
  - in **good condition.**

- **Segregate chemicals by compatibility.**
  Use secondary containment trays for segregation.

- **No more than** 55 gallons of waste or more than 1 quart of acutely hazardous waste may be stored.

Labeling Requirements:

- Label hazardous waste container with words **"Hazardous Waste."**

- Each container **must** be labeled with **full name of chemical contents**. Abbreviations or chemical formulas **are not** acceptable.

Call 785-3551 for waste removal

* Accumulation Area must be **at or near point of waste generation**.
This posting is required in each area where hazardous waste is accumulated.

Yale University
Office of Environmental Health & Safety 135 College Street 785-3550

3.8 Appendix H - Deactivation Procedures

Many chemicals used in the laboratory can be made less or even non-hazardous by lab personnel. Procedures for deactivating some chemicals are explained below. Incorporate these procedures into the experimental protocol, whenever possible, and call ESS if you have a specific chemical of interest that is not listed below.

General Safety Guidance for Acid: Base Neutralizations:

- Use a chemical fume hood and work behind a safety shield.
- Wear chemically resistant gloves, goggles or safety glasses or face shield, lab coat, and plastic or rubber apron.
- Work slowly and keep solutions cool in an ice bath to reduce the generation of heat and fumes.
- Always add acid to water or base to water. NEVER THE REVERSE.

Acid Neutralization:

- Slowly add dilute (5N or less) acid solution to a large dilute amount of an ice water mixture of either sodium carbonate, calcium hydroxide, potassium hydroxide, or 10M sodium hydroxide.
- Stir constantly while adding acid.
- Check pH frequently (acceptable range is 5.5 to 9.5).
- Flush down sink with 20 parts of water.
- Some acids should never be neutralized, due either to their high reactivity, creation of toxic residues, or other high inherent hazards. These include:

  -acetic acids.
  -acid anhydrides and chlorides.
  -chlorosulfonic acid.
  -chromic acid.
  -fuming nitric acid.
  -fuming sulfuric acid.
  -hydrofluoric acid.
  -liquid halides of boron, silicon, tim, titanium, and vanadium.
  -liquid halides and oxyhalides of phosphorus, selenium, and sulfur.
  -TriChloro- and trifluoro- acetic acids.

Base Neutralization:

- Dissolve solid base in a large volume of iced water, stir well.
- Slowly add a 1N or 2N solution of hydrochloric acid (HCL).
- Check pH frequently (acceptable final pH range is 5.5-9.5).
- Flush down sink with great excess of cool tap water.

Ethidium Bromide (EB):

Ethidium bromide is commonly used in molecular biology laboratories for visualizing nucleic acids and as a running buffer in electrophoresis. While it is not regulated as hazardous waste, it is a known mutagen and therefore must be handled with care:

- Highly dilute aqueous solutions less than 10 mg/l (i.e. <10 ug/mL) can be disposed of in the sanitary sewer.
- Alternatively, you may use an EB deactivation procedure. One such procedure was developed by Margaret Ann Armour and recently validated by the Ames test, which showed that the final product was no more mutagenic than controls

  -In a fume hood, dilute the EB solution to a final concentration of <30 mg/L (=30 ug/mL).
  -Add 10 ml of household chlorine bleach for every 1 mg of EB.
  -Stir at room temperature for 2 hours.

-The product solution is the physiologically inactive 2-carboxybenzophenone and can be rinsed down the sanitary sewer with a 20-fold excess of water.

Reference:

Armour, Margaret-Ann, Second Edition, "Hazardous Laboratory Chemicals Disposal Guide", Lewis Publishers, 1996.

Diaminobenzidine (DAB)

- Dilute DAB with water to a final concentration of less than 0.9 g/L (0.9 mg/mL.) If the initial solution was made with a buffer, use that same buffer to reach final dilution.
- Working in a fume hood: For each 10 ml of DAB solution, add 5 ml of 0.2M potassium permangenate ($KMn0_4$) solution and 5 ml of 2M sulfuric acid ($H_2\ SO_4$).
- Allow to stand overnight at room temperature, decolorize the solution by slowly adding and mixing in sodium ascorbate, and neutralize the product to a final pH between 5.5 to 9.5.
- Analyze for completeness of destruction and discard down the drain.
- For further details on the process, consult:

Reference: Lunn, G. and Sansone, E.B.: The Safe Disposal of DAB. *Applied Occupational Environmental Hygiene 6 (1): 49-53,* 1991

3.9 Appendix I - Facilities and Contractor Issues

The hazardous chemical waste requirements detailed in this manual are fully applicable to physical plant, utilities, facilities, and contractor operations. Hazardous waste determination and satellite storage requirements must be strictly adhered to. Often facilities operations create larger amounts of waste. If the amount of hazardous waste generated exceeds 55 gallons (or 1 quart of acutely hazardous waste) in one generation area, arrangements must be made to remove the waste within three days, or to adhere to more stringent storage requirements. If greater than 55 gallons of hazardous waste must be kept for greater than three days, contact ESS to make the proper arrangements. Requirements for certain waste streams that facilities and contractors handle are detailed below.

3.9.1 Fluorescent Lamps

Fluorescent lamps contain mercury and are considered hazardous waste. Follow guidelines below:

- Do not break spent lamp.
- Whenever possible, package spent lights in the original containers.
- Label containers as "Hazardous Waste-Mercury Fluorescent Bulbs" and call ESS for pick-up.
- If lamp is broken, place broken pieces in an imperious container, label it with - “Hazardous Waste-Broken Mercury Fluorescent Bulbs”, and call ESS.
- Do not mix fluorescent lamps with incandescent bulbs.
- See Appendix J for disposal guidelines.

3.9.2 Fluorescent Light Ballasts

Ballasts are used in fluorescent light fixtures. Many ballasts contain an oil filled capacitor which may contain PCBs.

- Check ballast label. If label says “No PCB’s” the ballast can be disposed of as waste oil. If there is only a small number of these "No PCBs" ballasts, they can be placed in the PCB drum. If label does not say “No PCB’s” assume that it could contain PCB’s and handle accordingly.
- Place ballast suspected of containing PCB’s in a drum, label as PCBs, and call ESS for pick-up. See Appendix K for Ballast Guidance document.

3.9.3 Lead Paint

Paint chips from lead waste removal is usually considered hazardous waste. ESS can make arrangements for the testing of paint waste to determine if the lead is above regulatory levels.

See Appendix L for lead paint waste guidance document.

3.9.4 Parts Washers

All parts washers must be registered with ESS. Parts washers that use non-hazardous (high flash-point) solvents should be utilized if possible. Contact ESS for information on these units. If a parts washer with a hazardous solvent is used, or if the parts being cleaned make the waste solvent hazardous chemical waste, proper disposal procedures must be followed. In most cases parts washers are on a monthly service contract, during which solvent is removed and replaced. It is required that any waste solvent that is a hazardous waste be shipped on a properly completed hazardous waste manifest. ESS should be contacted to review and sign manifests prior to off-site removal. In some cases, if it is impractical for ESS personnel to sign manifests, ESS will authorize properly trained on-site personnel to sign these documents. In these cases, generator copies of manifests must be delivered immediately to ESS.

3.9.5 Mercury Containing Switches and Thermostats

Mercury containing devices are considered hazardous waste. Follow guidelines in Appendix M. Mercury can collect in sink and vacuum line traps. Contain areas with bucket prior to opening trap. The mercury then must be paced in closed container and labeled properly.

3.9.6 Asbestos

Asbestos can be found in lab benches, fume hoods liners, insulation, and floor tile. Contact OEHS at 785-3550 to arrange for testing of suspected asbestos containing material. Asbestos is considered a Connecticut regulated waste and must be disposed at approved disposal sites. Only state licensed asbestos abatement contractors may remove or dispose of these materials.

Asbestos should be double bagged, bags taped shut, and labeled “Asbestos”. Call 785-3550 to arrange for disposal.

3.9.7 Pesticides

Pesticides may either be a characteristic or listed hazardous waste, or a Connecticut regulated waste. Contact ESS for disposal of all waste pesticides. Waste pesticide must be stored in accordance with all applicable hazardous waste storage requirements.

3.10 Appendix J - Fluorescent Lamp Guidance

Yale University
Office of Environmental Health and Safety
Environmental Services Section
Fluorescent Lamp Guidance Document for Contractors

A. Regulatory Status

1. Fluorescent lamps are considered to meet the definition of hazardous waste due to the amount of mercury and MUST be handled in the following manner:
   - all lamps are sent off-site for recycling
   - all lamps sent off-site shall be manifested
   - manifests are to be signed by a member of Environmental Services Section (ESS) of the Office of Environmental Health and Safety (OEH&S) at Yale University (785-3551)

B. Container Management

1. Place lamps into sturdy cardboard boxes for storage and shipment
   - boxes are provided by ESS
   - original bulb boxes may also be used
2. Label each box with the words "Hazardous Waste" and "Mercury Fluorescent Lamps"
   - these two phrases MUST be on each container
   - it is a violation of state and federal regulations not to have these labels
   - labels are provided by ESS
3. Date each box when lamps are first added
4. Tape both ends of each box securely
5. Store boxes in a secure dry area, preferably locked, away from public access

C. Other Important Items

1. Daily inspections of the work areas should be done by the site manager to assure no lamps have broken and that all boxes are properly labeled
2. Any lamps that break should be cleaned up immediately and the broken glass placed into a plastic lined box labeled as hazardous waste, Mercury Fluorescent Lamps.
3. Spill cleanup materials are to be provided by the contractor and should include:
   - Broom and dust pan
   - Plastic lined cardboard box
4. If any regulatory agency should come on site (OSHA, CTDEP, EPA)
   - ask the representative to wait until a member of OEH&S arrives
   - contact OEH&S immediately (785-3555) with the name of the representative and the agency
   - DO NOT deny the representative access to the site, but request that the inspectors wait the arrival of an OEH&S representative

D. In the event of a spill or accident involving fluorescent bulbs, the following people should be notified:

The Office of Environmental Health and Safety emergency number 785-3555

-AND-

Company performing the lamp removal

Call 785-3550 with any questions about storage

3.11 Appendix K - Ballast Guidance

Yale University
Office of Environmental Health and Safety
Environmental Services Section
Ballast Guidance Document for Contractors

A. Regulatory Status
   1. PCB containing ballasts are regulated by Connecticut as CT Regulated Waste (CR01)
      - all ballasts are sent off-site for recycling
      - a non-hazardous waste manifest is used
      - manifests are to be signed by a member of Environmental Services Section (ESS) of the Office of Environmental Health and Safety (OEH&S) at Yale University (785-3551)

B. Container Management
   1. Place ballasts into a DOT approved 55 gallon drum with a secure lid
      - 55 gallon drums are provided by ESS
   2. Write the accumulation start date on the label affixed to the drum
   3. Keep the drum closed unless ballasts are being added
   4. Fill drums to 3/4 full
   5. Store drums in an area posted with a PCB storage label (to be provided by ESS).
   6. Where possible, store drums in a 6 inch bermed area. If the drums are not stored in a bermed area, they must be removed from the storage area within 30 days of the accumulation start date. In order to ensure timely removal, please call 21 days after the accumulation start date to have the drums picked up by ESS.
   7. Store drums in a secure, dry area away from public access

C. Other Important Items
   1. Daily inspections of the work areas should be done by the site manager to assure no drums are left uncovered or any ballasts are left lying on the ground
   2. Any ballasts that have broken apart or are leaking a black tarry substance should be wrapped in plastic and kept separate from unbroken ballasts
      - if broken or leaking ballasts are found, treat as above and contact ESS
   3. If any regulatory agency should come on site (OSHA, CTDEP, EPA)
      - ask the representative to wait until a member of OEH&S arrives
      - contact OEH&S immediately (785-3555) with the name of the representative and the agency
      - DO NOT deny the representative access to the site, but request that the inspectors await the arrival of an OEH&S representative

D. In the event of a spill or accident involving ballasts, the following people should be notified:

The Office of Environmental Health and Safety emergency number 785-3555

-AND-

Company performing the abatement

Call 785-3550 with any questions about storage or disposal

3.12 Appendix L - Lead Paint Guidance

Yale University
Office of Environmental Health and Safety
Environmental Services Section

Lead Paint Guidance Document for Contractors

A. Regulatory Status

1. Lead paint chips or construction debris found to meet the definition of hazardous waste according to state and federal definitions MUST be handled in the following manner:

   (a) all waste is sent off-site for disposal
   (b) a hazardous waste manifest is used
   (c) manifests are to be signed ONLY by a member of Environmental Services Section (ESS) of the Office of Environmental Health and Safety (OEH&S) at Yale University (785-3551)

B. Container Management

1. Lead paint chips or debris are to be stored in a DOT approved container with a secure lid.
   (a) container must be compatible with the material to be stored
   (b) containers from 5 gallons to 55 gallons can be provided by ESS if requested in advance (allow 3-5 days for delivery)
   (c) larger containers (ex. 40 cubic yard roll-offs) can be provided by the disposal vendor with the appropriate planning lead time. Call ESS in advance to arrange delivery
2. Keep the container closed unless material is being added.
3. Label each container with the words "Hazardous Waste" and "Lead Paint".
   (a) these two phrases MUST be on each container
   (b) it is a violation of state and federal regulations not to have these labels
   (c) labels are provided by ESS
4. If plastic bags are used to hold paint chips before addition to the larger drums, each plastic bag MUST also be labeled with the words "Hazardous Waste" and "Lead Paint".

   (a) tie each bag securely before placing into drums
   (b) bags that are torn must be double bagged
5. Date each drum when material is first added.
6. Drums must be stored in a secure dry area, preferably locked, away from public access
7. Weekly inspections of the containers shall be carried out by a member of ESS
8. Daily inspections of the work areas should be done by the site manager to assure no lead paint chips or debris have spilled on the ground, that any spills are promptly cleaned up, and that all drums are closed and properly marked.

3.13 Appendix M - Mercury Containing Devices

Yale University
Office of Environmental Health and Safety
Environmental Services Section

Mercury Containing Switches and Thermostats Guidance Document for Contractors

A. Regulatory Status

1. Mercury containing devices are hazardous waste according to state and federal definitions and must be handled in the following manner:

   a) all waste is sent off-site for disposal.
   b) a hazardous waste manifest is used.
   c) manifests are to be signed ONLY by a member of Environmental Services Section (ESS) of the Office of Environmental Health and Safety (OEHS) at Yale University (785-3551).

B. Container Management

1. Mercury containing devices are to be stored in a DOT approved container with a secure lid.

   a) container must be compatible with the material to be stored.
   b) containers from 5 gallons to 55 gallons can be provided by ESS if requested in advance (allow 3-5 days for delivery).

2. Keep the container closed unless material is being added.

3. Label each container with the words “Hazardous Waste” and “Mercury”.

   a) these two phrases MUST be on each container.
   b) it is a violation of state and federal regulations not to have these labels.
   c) labels are provided by ESS.

4. Date each drum when material is first added.

5. Drums must be stored in a secure, dry area, preferably locked, away from public access.

6. Weekly inspections of the container(s) shall be carried out by ESS.

7. Daily inspections of the work areas should be done by the site manager to ensure that all mercury containing devices are in proper containers, and that all containers are closed and properly marked.

3.14 Appendix N - Special Waste Items for Collection

3.14.1 Batteries

- Alkaline and carbon-zinc batteries used in flashlights, beepers, radios, etc. can be safely disposed in the regular trash. All other batteries, however, should be collected for recycling.
- Mercury-oxide: Batteries used in cameras, calculators, instrumentation, etc. Mercury oxide batteries may be button style or may sometimes look like general-purpose batteries. Handle as hazardous waste.
- Lithium: Also found in button or general purpose format. Collect for recycling by ESS.
- Nickel-Cadmium: Rechargeable batteries such as for cell phones. These are also found in button or general purpose format. Handle as hazardous waste.
- Lead-Acid Batteries: This type is typically the wet cell car battery but may include gel batteries in various shapes. Lead-acid batteries are also considered hazardous waste unless managed for recycling. Automobile-style lead-acid batteries should be returned to an automotive store that accepts used batteries. Most automotive stores give a credit for these batteries when purchasing a new battery.

3.14.2 Compressed Gas Cylinders

- The majority of compressed gases used on campus are inert and non-toxic. However, some contain highly toxic or reactive materials that require special handling.
- Use refillable gas cylinders whenever possible. Call ESS at 785-3550 for information on these cylinders. Return to supplier when empty. Avoid lecture bottles whenever possible.
- Users should carefully evaluate their processes to avoid over-ordering.
- If you have a cylinder that cannot be returned to the original supplier, call ESS arrange for appropriate disposal.

3.14.3 Ethidium Bromide (EB)

As described in Appendix H, highly dilute aqueous solutions of EB may be disposed into the sanitary sewer system. However, EB solutions >10 mg/L (= 10 ug/mL) require either in-lab-deactivation or collection by ESS for disposal. Where possible, use the deactivation procedure for EB (Appendix H) as part of your experimental protocol. Acrylamide and agarose gels containing EB at ordinary electrophoresis concentrations can be disposed of in the normal trash due to their very low concentration. Please remember that gels used for radioactive materials must continue to be collected as radioactive waste.

3.14.4 Metallic Mercury

Metallic mercury found in manometers, thermometers, switches, old-style thermostats, and pressure or temperature equipment is present in many labs and facilities on campus. If mercury needs to be disposed of, place the device in a plastic bag, seal or tape tightly shut, place the bag in a small box, and tag the box with a Hazardous Waste disposal tag. Alternatively, designate a wide mouthed plastic jug for storage of broken thermometers, etc, label as “Hazardous Waste,” and indicate contents as “Mercury.” Remember to keep tightly capped. Call ESS for pick-up when the container is full. See Appendix M for contractor guidance document.

3.14.5 Waste Oil

Although waste oils such as pump and hydraulic oils are not a hazardous waste unless contaminated with solvents or metals, they are considered a Connecticut DEP regulated waste. Waste oil is picked-up by ESS and bulked into 55 gallon containers. Do not contaminate waste oil with hazardous chemicals. A vendor samples the oil for hazardous materials before taking it for recycling. Waste oil contaminated with hazardous materials must be disposed of as hazardous waste. Waste oil containing PCBs must be treated accordingly (see below).

3.14.6 Paint and Painting Supplies

Paints and material contaminated with paint often pose potential environmental hazards. Oil and certain latex paints (those with mildewcidal additives) generally contain hazardous chemicals, and oil based paints are frequently flammable and a fire hazard. Safely manage paint wastes as follows:

- Do not mix different types of paints or solvents.
- Make sure containers are sealed and do not leak.
- If original label is missing, re-label the container with a description of content.
- Place accumulated paint in the designated accumulation area for pick-up.
- Brushes and other supplies used with latex paint may be rinsed with tap water and drained to sewer, but thinners and solvents used for oil-based paints must be collected as hazardous waste.
- For non-mildewcide-containing latex paints, residues can be evaporated to dryness and then thrown out as ordinary trash.

3.14.7 Photographic Chemicals and Silver Recovery

Photographic chemical solutions that contain 5 mg/L or greater silver are considered to be a characteristic hazardous waste. Most fixer solutions from manual and automatic processing contain silver levels above 5 mg/L. Developer and stop solutions normally contain lower levels of silver but should be tested to verify. The solutions that contain 5 mg/L or greater silver cannot be put into the sanitary sewer unless the silver level is reduced to less than 5 mg/L. There are two ways to handle these solutions.

- Use of a silver recovery unit. Silver containing solutions are trickled through a unit containing fine iron wire or mesh. The silver comes out of solution onto the iron mesh. The solution can then be tested for silver, if the level is below 5 mg/L the solution can be disposed of through the sanitary sewer. For best silver recovery two units are used in tandem or "piggy backed". Higher levels of silver may require the use of an electrolytic recovery unit prior to the iron cartridges. Proper maintenance and testing of these units is very important and can be done by vendor under contract for these services. Contact ESS for more information on these vendor contracts. ESS has obtained a permit from the CTDEP for the discharge from these units. Prior to installing a silver recovery unit contact ESS at 785-3550 to be added to the list of permitted discharge locations and for testing requirements. Laboratory analysis of the untreated fixer and of the treated effluent is required on a monthly basis. Also, to avoid spills, all discharge lines from these units should be securely fastened to drain locations.
- Pick up of silver bearing solutions by Environmental Services Section. Any silver bearing solutions or unused photographic chemicals should be tagged as hazardous or chemical waste as appropriate and called in for pick up by ESS.

3.14.8 Polychlorinated Biphenyls (PCBs):

Materials containing PCBs at concentrations over 50 ppm are regulated by the EPA under the Toxic Substance Control Act (TSCA). The following guidelines should be followed to properly dispose of liquids or oils containing PCB's:

- Store in a glass container with a tight-fitting cap that does not leak. Do not place PCB materials in solvent carboys.
- Clearly label that the contents are PCB's.
- Keep track of concentration of PCB's in the container.
- PCB contaminated equipment (e.g. gloves, labware):

  Place contaminated material in a heavy plastic bag and seal. Place the bag in another bag (double bag), seal with tape and place inside a box. Identify PCB concentration and label accordingly.

- Electrical equipment containing PCB oil (e.g. capacitors, transformers, voltage regulators). These items should be stored in plastic trays containing an absorbent to contain and absorb any spills or leaks. See guidance in Appendix K.
- Disposal of PCB electrical equipment is strictly regulated by the EPA. ESS provides for sampling and analyses for PCB's and for disposal of oil-filled electrical items. Call ESS for assistance and information.

3.15 Appendix O - Spill Prevention and Response Guideline (also see Chemical Hygiene Plan)

- ♦ Chemical containers should not be left on the floor or in aisles where they can be kicked or knocked over.
- ♦ Store chemicals in compatible containers (i.e., do not place acids in metal can or solvents in incompatible plastic container) and use a secondary container or tray for corrosive reagents and all waste chemicals.
- ♦ Chemical containers should not be stacked where there would be any danger of toppling, breakage, or spillage of contents.
- ♦ Examine box integrity before moving chemicals. Remove containers if box is damaged and transportation would cause a chemical release.
- ♦ Follow safety guidelines when transporting hazardous chemicals (see Appendix P).

3.15.1 Minor Chemical Spill

- Alert people in immediate area of spill.
- Increase ventilation in area of spill (open windows, turn on hoods).
- Wear protective equipment, including safety goggles, gloves, long-sleeve lab coat and closed toe shoes.
- Avoid breathing vapors from spill.
- Prevent the spill from spreading by returning container to the up-right position or placing into secondary containment.
- Consult MSDS for chemical information.
- Use appropriate kit to neutralize and absorb inorganic acids and bases. Collect residue, place in container, and dispose as chemical waste.
- For other chemicals, use appropriate kit or absorb spill with vermiculite, dry sand, diatomaceous earth or paper towels. Collect residue, place in container, and dispose as chemical waste.
- Always work from the perimeter of a spill area inwards to avoid stepping into and tracking contamination.
- Clean spill area with water as appropriate.
- Contact OEHS emergency line at 785-3555 (M-F 8:30AM-5PM) or campus police at 111 or 432-4400 at other times if you need advice or further assistance.

3.15.2 Major Chemical Spill

- Attend to injured or contaminated persons and remove them from exposure.
- Alert people in the area to evacuate.
- If spilled material is flammable, turn off ignition and heat sources. Place material (e.g., plastic bag) over spilled material to keep substance from volatilizing.
- Call Chemical Spill Emergency Response number 785-3555 (M-F 8:30AM-5PM) or campus police at 111 or 432-4400 at all other times.
- Close doors to affected area.
- Have a person with knowledge of the incident and area available nearby to answer questions from responding emergency personnel.

3.15.3 Mercury Spills

- *Small Mercury Spill* (amount in health-care or laboratory thermometer or less).
  - – Use a vacuum line with an in-line dry trap attached to a tapered glass tube (i.e., medicine dropper or small Pasteur pipette) to pick up mercury droplets. A syringe with a narrow gauge needle may also work. Do not use a domestic or commercial vacuum cleaner.
  - – Cover small droplets in inaccessible areas with either powdered sulfur or zincs.
  - – Place residue in a labeled container and call ESS for disposal.

- *Large Mercury Spill*
  - Leave area and close doors.
  - Keep other people out of the area to avoid tracking mercury contamination.
  - Call emergency number given above. The Office of Environmental Health & Safety has a vacuum specifically designed to collect mercury, special spill collection equipment and will assist you.

3.15.4 Alkali Metal Spills

Smother with powdered graphite, sodium or calcium carbonate, "Met-L-x" fire extinguisher, or sand, and call for assistance.

3.15.5 White Phosphorus

Smother with wet sand or wet "noncombustible" absorbent or use a "Met-L-x" fire extinguisher and call for assistance.

3.16 Appendix P - Transportation of Hazardous Materials

3.16.1 Transportation of Hazardous Materials or Hazardous Waste in Vehicles

Do not transport hazardous waste or hazardous materials in personal vehicles. DOT requires hazardous materials to be properly classified, packaged, labeled, and manifested prior to shipment. If you need to ship or transport a hazardous material in an on-road vehicle, please contact ESS. If it is a radioactive material, please contact the Radiation Safety Section, Office of Environmental Health and Safety.

Special training is required for any individual engaging in any aspect of hazardous materials transportation, including preparing packages for shipment, loading or unloading vehicles, and operating a vehicle used to transport hazardous materials.

If you do not have the proper training, proper packaging and labeling, and the proper containers and manifests, you cannot transport or prepare for transport hazardous materials.

3.16.2 Transportation of Hazardous Materials Inside of Buildings or While on Foot

Transporting chemicals can be dangerous. Besides direct physical injury, transport accidents can cause spills and splashes of highly concentrated hazardous materials. Keep the following guidelines in mind whenever transporting chemicals through hallways and especially when using elevators:

Observe common courtesies. Yield the right-of-way to people pushing carts or carrying supplies. Approach hallway corners with caution, and beware of doorsills, elevators, and irregular floor surfaces.

Use a chemical carrier or other form of secondary containment when transporting hazardous chemicals such as flammable, toxic, and corrosive liquids. Understand the hazards of materials you work with. Before moving any material, consider what could happen if the were dropped and broken. Always use a secondary container such as a chemical carrier for liquid flammable, toxic, and corrosive chemicals. The stockrooms will not allow you to take these chemicals from the stockroom without secondary containment!

Never overload yourself. When carrying materials, keep one hand free at all times, if two hands are needed, use a laboratory cart or box.

Respect inertia. Once in motion, objects tend to remain in motion (Newton 1687). If stopped suddenly (say, to avoid a collision, or a wheel gets stuck on a doorsill), the materials on a cart will continue to move forward and may fall off. Load carts accordingly by wedging items together to reduce this risk.

Accidents will happen. In the event of an accident, remember that your most important response is to summon emergency assistance by dialing 785-3555 from any campus telephone. Remain nearby at a safe distance from the scene until help arrives. Tell the emergency responders what happened. Report near misses to your supervisor or the Office of Environmental Health and Safety to help prevent future accidents.

3.16.3 Bulk Chemical Transfers

- To minimize spills and potential accidents, only Stockroom personnel are authorized to pump transfer chemicals.
- Impermeable gloves and appropriate eye protection must be worn while pumping chemicals.
- Receiving containers must be U.L. approved explosion-proof safety cans; no other containers may be filled.
- The secondary (receiving) containers must be labeled to indicate contents and hazard; stickers are available from the Stockroom.
- When transferring bulk chemical, both 55-gal drum and the secondary containers must be grounded with the bonding cable to avoid ignition by static electricity.
- In the event of an emergency, notify the Office of Environmental Health (785-3555) or Yale Police Department (x111).

3.17 Appendix Q - Multi-Hazardous ("Mixed") Waste

3.17.1 Introduction

Multi-hazardous or mixed waste is waste that contains any combination of chemical, radioactive, or biological hazards. Mixed waste requires special considerations because the treatment method for one of the hazards may be inappropriate for the treatment of another. Disposal of mixed waste is both technically difficult and expensive. For example if a waste that contains a volatile organic solvent and infectious agents is autoclaved, it may release hazardous levels of solvent to the environment. Management of mixed waste is complicated further by overlapping federal, state, and local regulations.

In general, if all the hazards cannot be removed by eliminating or substituting the materials that generate the mixed waste, then the goal is to reduce the multi-hazard waste to a waste that presents a single hazard. This can be managed by standard methods in that waste category, such as neutralization of a corrosive/radioactive material.

The general principles of mixed waste management are:

- waste minimization.
- training of lab personal and waste handlers.
- reviewing experimental procedures to minimize mixed waste generation.
- keeping classes of waste materials separate.
- properly identify all waste materials.

3.17.2 Chemical-Radioactive Mixed Waste

Examples of these mixed wastes include:

- used flammable (e.g. xylene) liquid scintillation cocktails.
- phenol-chloroform mixtures from extraction of radio-labeled nucleic acids.
- gel electrophoresis waste (e.g. methanol or acetic acid containing radionuclides).
- lead contaminated with radioactivity.
- aqueous solutions containing more than 6 ppm chloroform and radioactive material.

Rigorous application of waste minimization principles should be a priority in the management of mixed waste. The most successful methods are the ones involving modification of laboratory processes:

- use of smaller scintillation vials ("minivials") rather than standard 20 ml vials.
- counting P-32 without scintillation fluids by using the Cerenkov method.
- I-125 measurement without scintillation fluids in a gamma counter.
- use of micro-scale chemistry techniques .
- elimination of the methanol/acetic acid in gel electrophoresis work by skipping the gel fixing step if it is not essential.
- preventing lead contamination by radioactivity by lining lead containers with disposable plastic.
- when possible, substituting with less hazardous materials such as:
  - Non-ignitable scintillation fluids instead of flammable (see Radiation Safety Manual).
  - Non-radioactive techniques (e.g. chemiluminescense) for sequencing studies, DNA probe labeling, and southern blot analysis.
  - Substitute with shorter life radionuclides wherever possible (e.g. P-32 t ½ =14 days) in place of P-33 (t ½=25 days) or P-32 or P-33 in place of S-35 (t ½ =87 days) in nucleotides and deoxynucleotides.

3.17.3 Chemical-Biological Waste

These wastes include biological specimens preserved in formalin, and rodents or tissues that have been treated with hazardous chemicals. Commercial medical waste incinerators can destroy the small amount of toxic organic chemicals present in the animal tissues and may be a viable disposal option if the chemical concentrations are below regulated hazardous waste levels.

If autoclaving is used to sterilize infectious waste, care must be taken as it may result in the volatilization of the chemical constituents. Additional containment may be needed to minimize chemical releases but this may interfere with steam penetration and sterilization. Autoclaving waste containing flammable liquids may result in a fire or explosion. Steam sterilization of a waste that contains bleach may harm an autoclave. Bleaching may be used for sterilizing if it is compatible with the chemical constituent. The sterilized chemical-biological waste can be then managed as chemical waste, and the biohazard markings should be defaced.

3.17.4 Radioactive-Biological Waste

See Radioactive and Biomedical Waste Sections.

3.17.5 Chemical-Radioactive-Biological Waste

This type of mixed waste is often the most difficult to manage because of conflicting regulatory requirements or the impact that one treatment method may have on other constituents of the mixture. Decay in storage may eliminate the radioactive hazard, while autoclaving/disinfecting may destroy the infectious hazards, taking into consideration the precautions explained above. Some simple chemical methods, e.g. using bleach, may both oxidize toxic chemicals and disinfect biological hazards reducing the triple mixed waste to just radioactive. However, bleach should not be added to certain radioisotopes since volatilization may occur. If your work generates such a complex waste mixture, please contact OEHS to review potential management options.

Managing mixed waste is never easy. Please contact the OEHS at 785-3550 to discuss your waste streams and what steps could be taken to further reduce the volume and the hazard of the materials you work with.